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Kansas Entomological Society
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HOST RELATIONSHIPS IN THE GENUS *CROSSIDIUS* (Coleoptera, Cerambycidae)

E. Gorton Linsley
University of California, Berkeley

The genus *Crossidius* is confined largely to the arid regions of western North America, reaching its greatest development in the Great Basin Region. Insofar as known the larvae are all root borers in perennial fall-blooming Compositae, in particular *Chrysothamnus, Haplopappus, Artemisia,* and *Gutierrezia.* Adults frequent the blossoms of their host plants, where they assemble for mating as well as feeding on the pollen. They are diurnal, mostly yellow and black, but in some species brightly contrasting in red and black.

In some cases, sympatric species appear to avoid competition by segregation on separate hosts; in others they seem to be able to compete successfully over a wide range of conditions. The former situation obtains near Lancaster, California, where *Crossidius discoideus blandi, C. ruficollis ascendens,* and *C. intermedius minutivestis* all occur together, the first on *Gutierrezia lucida,* the second on *Chrysothamnus nauseosus,* the third on *Haplopappus acradenius,* although these plants are growing intermingled. The latter situation obtains with *Crossidius ater* which has been found on the same plants with *C. hirtipes* at Coleville and Prosser Creek, California, with *C. punctatus* at Boca Dam, California, and with *C. wickhami nubilus* at Westgard Pass, California, usually on *Chrysothamnus viscidiflorus. Crossidius pulchellus* and *C. discoideus blandi* have also been found on the same plants *(Gutierrezia lucida)* at various localities in California and Arizona.

Acknowledgments

I am greatly indebted to Helen K. Sharsmith of the University of California Herbarium for identifying a high percentage of the plants recorded here. Her identifications are indicated by an asterisk (*). I am also indebted to P. H. Timberlake for many valuable host records, to W. F. Barr for biological notes, and to my colleagues P. D. Hurd, J. W. MacSwain, and Ray F. Smith for making special efforts to obtain host-associated material. John A. Chemsak also assisted materially in field collections of the 1956 season. Other collectors are acknowledged in the text.

Host Records

Except as indicated by references to the literature, the following records are all taken from specimens actually seen by the writer. In most cases I have given the number of specimens involved and the sex of the individuals, as a basis for evaluating the record.

The genera *Chrysothamnus* and *Artemisia* were monographed by Clements and Hall (1923), *Haplopappus* by Hall (1928). These two works will be most helpful to the student of *Crossidius.*

Crossidius punctatus LeConte

This is a variable species and host-associated material has been taken on both *Chrysothamnus* and *Artemisia.* Records are as follows: Warner Creek Campground, Plumas County, California, August 16, 1956, on *Chrysothamnus viscidiflorus* Nutt., 2 females (E. E. Lindquist); Boca Dam, eleven miles east of Truckee, Nevada County, California, August 24, 1956, on *Chrysothamnus nauseosus speciosus* (Nutt.) Hall,* 1 female (E. G. Linsley); Sierraville, Sierra County, California, August 26, 1948, on *Chrysothamnus,* 1 female (E. G. Linsley); Portola, Plumas County, California, August 10, 1949, on *Chrysothamnus,* 1 female, 3 males (J. W. MacSwain); Lewiston, Idaho, August 15, 1951, on *Chrysothamnus,* 1 male (W. F. Barr); Dixie, Elmore County, Idaho, July 31, 1952, on *Chrysothamnus,* 1 male (W. F. Barr); Yreka, Siskiyou County, California, September 8-23, 1912, "on sage," males and females (R. Hopping); Lytton, British Columbia, August 16-23, 1921, on *Chrysothamnus,* females (G. J. Spencer); Basque, British Columbia, August 27, 1932, on *Artemisia tridentata* Nutt., females (G. Stace Smith); Kamloops, British Columbia, October 1, 1932, on *Artemisia tridentata,* females (G. Stace Smith).

Crossidius curticollis Casey

This species is closely related to the preceding. It has been taken on *Chrysothamnus viscidiflorus stenophyllus* (Gray) Hall at the following localities: four miles southwest of Ophir, Tooele County, Utah, August 9, 1953 (H. E. Cott, P. D. Ashlock); Hickman Canyon, Stansbury Mountain, Tooele County, Utah, August 18, 1953 (H. E. Cott); and Wig Mountain, Tooele County, Utah, September 19, 1953 (J. L. Eastin). Mr. Eastin also took a few males on *Chrysothamnus nauseosus* (Pall.) Britt., at Hickman Canyon on August 10, 1953.

In the Hickman Canyon series there are females with the pronotum marked precisely as in the type of *C. curticollis.* Other examples agree quite well with *C. parallelus* Casey, *C. vinosus* Casey and *C. hirsuticollis* Casey, all of which I regard as synonyms of *curticollis.*

Crossidius mojavensis Linsley

This species has been found only in the vicinity of Palmdale, Los Angeles County, California. It is associated with *Chrysothamnus nauseosus gnaphalodes* (Greene) Hall.*

Crossidius ater LeConte

This is a widely distributed and variable Great Basin species. Plant associated records are as follows: Prosser Creek, two and one-half miles south of Hobart Mills, Nevada County, California, August 23-28, 1956, on *Chrysothamnus viscidiflorus typicus* Hall,* 58 females, 106 males (E. G. Linsley, J. M. Linsley); Boca Dam, eleven miles east of Truckee, Nevada County,

California, August 24, 1956, on *Chrysothamnus nauseosus speciosus* (Nutt.) Hall,* 1 male (E. G. Linsley); Westgard Pass, Inyo County, California, September 11, 1956, on *Chrysothamnus viscidiflorus typicus,** 2 females, 3 males (P. D. Hurd); same locality and date on *Chrysothamnus nauseosus gnaphalodes,** 2 females, 3 males (J. A. Chemsak, E. G. Linsley); six miles north of Yerington Junction (ten miles west of Wellington), Nevada, September 30, 1956, on *Chrysothamnus,* 1 female, 5 males (P. H. Timberlake).

Crossidius wickhami Casey

Crossidius wickhami Casey occurs in western Utah, eastern Nevada, and northern Arizona. It has been collected mostly on *Chrysothamnus viscidiflorus stenophyllus* (Gray) Hall. Host-associated material is before me as follows: four miles northeast of Camelback Mountain, Tooele County, Utah, September 1, 1953, on *Gutierrezia* sp. (H. E. Cott, J. L. Eastin); same locality, September 7, 1954, on *Chrysothamnus viscidiflorus stenophyllus* (J. L. Eastin); same locality, September 14, 1954, on *Chrysothamnus viscidiflorus stenophyllus* (J. L. Eastin); Wig Mountain, Tooele County, Utah, September 10, 1953, on *Chrysothamnus viscidiflorus stenophyllus* (J. L. Eastin); Little Granite Mountain, Tooele County, Utah, August 31, 1953, on *Chrysothamnus viscidiflorus stenophyllus* (H. E. Cott); and Pioche, Lincoln County, Nevada, September 26, 1936, on *Chrysothamnus* (I. McCracken).

Crossidius rhodopus Linsley

Crossidius rhodopus rhodopus Linsley is found along the southwestern edge of the Mono Basin on *Chrysothamnus viscidiflorus.* Host-associated material is as follows: Grant Lake, Mono County, California, September 5, 1948, on *Chrysothamnus viscidiflorus typicus,** 8 males (P. D. Hurd and J. W. MacSwain); Sherwin's Summit, Mono County, California, September 10, 1956, on *Chrysothamnus viscidiflorus puberulus* (Greene) Hall,* 9 females, 45 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley).

Crossidius rhodopus nubilus Linsley occurs east of the Owens Valley in the pass between the White Mountains and the Butte Mountains. Host-associated material has been taken as follows: Westgard Pass, Inyo County, California, September 11, 1956, on *Chrysothamnus viscidiflorus typicus,** 10 females, 36 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley); same locality and date, on *Chrysothamnus nauseosus gnaphalodes* (Greene) Hall, 7 females, 13 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley). A female from Las Vegas, Nevada, October 30, 1952, on *Chrysothamnus nauseosus gnaphalodes** (Ray F. Smith), previously referred to *rhodopus* (Linsley, 1955:65) may possibly belong here. However, a series of specimens from this locality is required before its status can be determined.

Crossidius testaceus LeConte

This species was described from San Diego and the Colorado River, on *Baccharis* (LeConte, 1851:102). However, all of the host-associated material which I have seen has been from *Haplopappus venetus vernonioides* (Nutt.) Hall. This is true of a long series of specimens taken at Riverside, California,

over a period of more than thirty years between September 3 and October 23 by P. H. Timberlake. Other records include six miles west of Riverside, California, October 20, 1951, on *Haplopappus venetus vernonioides* (P. D. Hurd); La Jolla, San Diego County, California, August 20, 1934, on *Haplopappus venetus vernonioides* (P. H. Timberlake); thirty-two miles south of Tijuana, Baja California, August 31, 1934, on *Haplopappus venetus vernonioides* (P. H. Timberlake); thirty-one miles north of Ensenada, Baja California, August 31, 1934, on *Haplopappus venetus vernonioides* (P. H. Timberlake).

Crossidius australis Linsley

C. australis is related to *C. testaceus* but is more coarsely punctate, with a shining pronotum and a dark sutural vitta on the elytra. It has been taken by E. S. Ross and A. E. Michelbacher on *Haplopappus parishii* (Greene) Blake at the following localities in Baja California: San Quintin, August 2, 1938; Hamilton Ranch, August 2, 1938; and Rio San Telmo, August 3, 1938. Examples have been captured recently in the same vicinity at Santo Domingo, August 13, 1954 (J. Powell) and Boca de Santa Maria, August 12, 1954 (J. Powell).

Crossidius ruficollis Linsley

This species occurs in several rather well-marked California races. The typical form, *C. ruficollis ruficollis* Linsley (testaceous and black with pronotum somewhat reddish and elytral markings of female black) occurs in Kern County (foothills southeast of Bakersfield to Buttonwillow and Shafter), Kings County (Kettleman City), Tulare County (Pixley, Tipton, Visalia) and Fresno County (Mendota), on *Haplopappus acradenius bracteosus* (Greene) Hall* (Linsley, 1955:65). A female taken on this plant, eleven miles east of Cholame, San Luis Obispo County, October 3, 1956 (H. Graham), also appears to represent this type. However, in the Medota-Firebaugh area (Fresno County), populations occur which are reddish rather than testaceous (bright red in the female, with elytral markings black and similar to those of the typical form). This form also occurs on *Haplopappus acradenius bracteosus*. In the Salinas Valley near San Miguel, the population is testaceous and black, as in the southern San Joaquin Valley; but the basal black margin of the elytra in the female is evanescent, and the elytra of the male uniformly testaceous in all except one example. It has been captured as follows: three miles east of San Miguel, San Luis Obispo County, California, October 5, 1956, on *Haplopappus acradenius bracteosus*,* female (H. Graham, Ray F. Smith); same locality, October 17, 1956, on *Haplopappus acradenius bracteosus*,* 12 females, 28 males (H. Graham, K. S. Hagen, Ray F. Smith). In these San Joaquin and Salinas Valley populations there is a limited tendency toward infuscation of the pronotum, less commonly expressed in the female than in the male.

On the western edge of the Mojave Desert from the Tehachapi Mountains to Lancaster, on *Chrysothamnus nauseosus mohavensis* (Greene) Hall,* red and black populations (*C. ruficollis ascendens* Linsley) occur in which the elytral markings are bluish and, in the females, much more ex-

tensive than in the corresponding sex of the San Joaquin and Salinas Valley populations. It has been captured as follows: three miles east of Monolith, Kern County, September 8, 1956, on *Chrysothamnus nauseosus mohavensis,** 3 females, 9 males (J. A. Chemsak, P. D. Hurd); four miles east of Monolith, Kern County, October 24, 1952, on *Chrysothamnus nauseosus mohavensis,** 14 females, 12 males (Ray F. Smith); Mojave, Kern County, October 15, 1925, female and male (R. Hopping); two miles south of Rosemond, Kern County, October 24, 1952, on *Chrysothamnus nauseosus mohavensis,** 1 female, 3 males (Ray F. Smith); and two miles north of Lancaster, Los Angeles County, September 8, 1956, on *Chrysothamnus nauseosus mohavensis,** 9 females, 23 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley), ignoring *Haplopappus acradenius* which grows and blooms with it.

In the Owens Valley, *C. ruficollis caeruleipennis* Linsley occurs on *Chrysothamnus nauseosus consimilis* (Greene) Hall.* These populations are testaceous and black with the pronotum somewhat rufotestaceous (as in the typical form). In the male, the elytra are immaculate (36 per cent of the individuals in our samples) or with a narrow posterior sutural stripe. In the female, the elytral markings are relatively constant and the pattern resembles that of the San Joaquin Valley populations, but the dark areas are blue as in the Mojave Desert forms. Collections have been made as follows (south to north): one and one-half miles south of Lone Pine, Inyo County, September 9, 1956, on *Chrysothamnus nauseosus consimilis,** 7 females, 19 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley); eight miles north of Lone Pine, Inyo County, September 9, 1956, on *Chrysothamnus nauseosus consimilis,** 5 females, 36 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley); eight miles south of Big Pine, Inyo County, September 9, 1956, on *Chrysothamnus nauseosus consimilis,** 4 females, 23 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley); four miles south of Big Pine, Inyo County, September 9, 1956, on *Chrysothamnus nauseosus consimilis,** 14 females, 37 males (J. A. Chemsak); Round Valley, Inyo County, September 10, 1956, on *Chrysothamnus nauseosus consimilis,** 7 males (J. A. Chemsak, E. G. Linsley); two miles south of Keogh Hot Springs, Inyo County, September 10, 1956, on *Chrysothamnus nauseosus consimilis,** 1 male (E. G. Linsley); Rock Creek, Inyo County, September 11, 1956, on *Chrysothamnus nauseosus consimilis,** 6 females (J. A. Chemsak, P. D. Hurd, E. G. Linsley); and fifteen miles north of Bishop, Inyo County, August 8, 1948, on *Chrysothamnus,* 3 females, 13 males (P. D. Hurd, J. W. MacSwain).

In the lower part of the Mono Basin small samples suggest that the population has a smaller average size than that of the Owens Valley, with a tendency toward a subapical expansion of the sutural stripe in the male. Host plant data are not available for this form, but it has been collected as follows: One mile south of Tom's Place, Mono County, September 7, 1948, 1 male (S. A. Sher); Mammoth, Mono County, August 7, 1936, 4 females, 2 males (G. E. Bohart); Whitmore Tubs, Mono County, August 12, 1936, 2 females, 2 males (F. R. Platt).

Crossidius jocosus (Horn)

C. jocosus resembles one of the red forms of *C. ruficollis,* but it is a little smaller, with the abdomen black, the integument dull and the pronotal tubercles more acute. It has been taken on *Gutierrezia sarothrae* Britt. & Rusby at Petrified Forest, Apache County, Arizona, August 27, 1931 (P. H. Timberlake). Knowlton and Thatcher (1936) record adults from *Chrysothamnus* but their records pertain to *Crossidius corallinus* (LeConte).

Crossidius cruentus (LeConte)

This species also suggests one of the red forms of *C. ruficollis,* but it is broader and opaque, with the base of the elytra red (not margined with black) and the metasternum reddish brown rather than black. It has been captured on *Gutierrezia californica* T. & G. at Riverside, California, September 19, 1945 (P. H. Timberlake).

Crossidius corallinus (LeConte)

C. corallinus has been taken on *Chrysothamnus nauseosus* (Pall.) Britt. at Dietrick Butte, Lincoln County, Idaho, August 25, 1956, female and male (T. Heller). Knowlton (1934) has recorded adults on "sage" and "rabbit brush" in Utah.

Crossidius inflaticollis Linsley

A male and female were captured by J. W. MacSwain on *Gutierrezia lucida* Greene,* five miles north of Carlsbad, Eddy County, New Mexico, September 15, 1956 (Linsley, 1957).

Crossidius hirtipes (LeConte)

This species was taken "on sage" (=*?Artemisia tridentata* Nutt.) by Ralph Hopping at the following localities: Oroville, Okanogan County, Washington, September 13, 1923, and Antelope Creek, Siskiyou County, California, August 15, 1914. P. C. Ting took a series of males and females in Eagle Valley, two and one-half miles northwest of Carson City, Ormsby County, Nevada, September 22, 1953, on *Chrysothamnus viscidiflorus* Nutt., and E. E. Lindquist captured a male two miles south of Carson City, Nevada, August 18, 1956, on a yellow-flowered composite which was either *Chrysothamnus* or *Haplopappus.*

Crossidius discoideus Say

This widely distributed species is associated with *Gutierrezia, Haplopappus* and *Chrysopsis* in various parts of its range. Plant-associated material assignable to *Crossidius discoideus blandi* Casey is as follows: two miles north of Lancaster, Los Angeles County, California, September 8, 1956, on *Gutierrezia lucida* Greene,* 10 females, 25 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley) (A few stragglers were also found on blossoms of *Chrysothamnus nauseosus mohavensis* which was growing with the *Gutierrezia.* However, the association appeared to be with the latter plant); eight and one-half miles south of Ivanpah, San Diego County, California, September 12, 1955, on *Gutierrezia lucida,* 3 females, 4 males (C. D. Mac-

Neill); three miles west of Vincent, near Acton, Los Angeles County, California, October 14, 1952, on *Gutierrezia lucida* (P. H. Timberlake); Riverside, California, July 17-November 10, in various years, on *Gutierrezia californica* T. & G., males and females (P. H. Timberlake); two miles south of Warner's Springs, San Diego County, California, September 19, 1938, on *Gutierrezia californica* (P. H. Timberlake); eight miles northeast of Douglas, Cochise County, Arizona, August 11, 1940, on *Chrysopsis,* female (P. H. Timberlake); four miles northwest of Tombstone, Cochise County, Arizona, August 13, 1940, on *Chrysopsis,* male (P. H. Timberlake); seven miles west of Fairbanks, Cochise County, Arizona, August 28, 1954, on *Haplopappus gracilis* (Nutt.) Hall, males and females (P. H. Timberlake); nine miles southeast of Fresnillo, Zacatecas, Mexico, August 7-14, 1954, on *Haplopappus spinulosus scabrellus* (Greene) Hall,* males and females (E. G. Linsley, J. W. MacSwain, Ray F. Smith).

Crossidius intermedius LeConte

This species resembles *C. suturalis* LeConte, but differs in the pale appendages. The typical form from Arizona has been recorded from *Haplopappus hartwegi* (Gray) Blake* at Tucson and from *Haplopappus drummondii* (T. & G.) Blake* at Gila Bend (Linsley, 1955:65-66). Additional records are as follows: Chandler Heights, southeast of Mesa, Maricopa County, Arizona, September 15, 1953, on *Haplopappus acradenius* (P. H. Timberlake); six miles east of Florence, Pinal County, Arizona, September 16, 1953, on *Haplopappus acradenius* (P. H. Timberlake).

The paler, less heavily marked, more densely pubescent form from southeastern California (*C. intermedius pubescens* Linsley) has been recorded from *Haplopappus acradenius eremophilus* (Greene) Hall* at various localities in Riverside and Imperial Counties (Linsley, 1955:66).

On the western Mojave Desert a form occurs (*C. intermedius minutivestis* Linsley) in which the elytra are much more shining and obscurely clothed with very short pubescence. This type has been taken two miles north of Lancaster, Los Angeles County, California, September 8, 1956, on *Haplopappus acradenius** (Five or six stragglers were also taken on flowers of *Chrysothamnus nauseosus mohavensis* which was growing with the *Haplopappus,* but the association was clearly with the latter plant), 11 females, 85 males (J. A. Chemsak, P. D. Hurd, E. G. Linsley).

Crossidius suturalis LeConte

This species differs from *C. intermedius* in the black legs and antennae. It has been recorded from *Solidago* at Albuquerque, New Mexico (Wickham, 1893:192. Referred to by Wickham as *C. longipennis* Casey, a synonym of *suturalis* LeConte). It has also been taken on *Haplopappus pluriflorus* (Gray) Hall at Laguna, New Mexico, September 4, 1940 (P. H. Timberlake); on *Chrysothamnus* fifteen miles south of Roswell, Chaves County, New Mexico, August 13, 1950 (J. W. MacSwain); and on *Chrysothamnus viscidiflorus* (Hook.) Nutt.* five miles north of Carlsbad, Eddy County, New Mexico, September 15, 1956, 6 females, 11 males (J. W. MacSwain).

At this last locality, three males were also found on blossoms of *Gutierrezia lucida* where the *Chrysothamnus* had dried up.

Crossidius allgewahri LeConte

C. allgewahri has been reared from the roots of *Chrysothamnus viscidiflorus* Nutt. four and one-half miles northwest of Terreton, Jefferson County, Idaho, August 9, 1955 (W. F. Barr) and seven miles southwest of Mt. Home, Elmore County, Idaho, August 5, 1955 (R. A. Mackie). Adults have been captured on the flowers of *C. viscidiflorus* at the Terreton locality, September 14, 1955 (R. A. Mackie) and Rock Creek Canyon, Twin Falls County, Idaho (W. F. Barr). Knowlton (1934) has recorded adults as abundant on both *Chrysothamnus* and *Gutierrezia* in Utah. Dr. Barr reports *(in litt.)* finding larvae of *Enoclerus acerbus* (Wolcott) preying upon larvae, pupae, and teneral adults of *C. allgewahri* in *Chrysothamnus* roots at Terreton. We have found *Enoclerus abruptus* LeConte associated with adults of *Crossidius* on flowers of *Chrysothamnus* at several localities in California, but have no direct evidence of a predator-prey relationship.

Crossidius pulchellus LeConte

Previously recorded as feeding in the roots of *Artemisia* (Craighead, 1923:81) and of *Gutierrezia sarothrae* (Pursh) Britton & Rusby in New Mexico and *G. lucida* Greene in Arizona and on blossoms of the latter plant at Morongo Valley, San Bernardino County, California (Linsley, 1955:66). Knowlton (1934:86) reports adults abundant on blooming *Chrysothamnus* and *Gutierrezia* in Utah. Additional records of plant-associated specimens are as follows: near Correo, Valencia County, New Mexico, September 4, 1930, on *Gutierrezia sarothrae* (P. H. Timberlake); near Tecolote, New Mexico, September 5, 1930, on *Gutierrezia sarothrae* (P. H. Timberlake); Ruidoso, Lincoln County, New Mexico, September 10, 1956, on *Gutierrezia sarothrae,** 6 females, 8 males (J. W. MacSwain); three and one-half miles south of Rodeo, Cochise County, Arizona, October 13, 1956, on *Gutierrezia sarothrae,** 21 females, 36 males (J. W. McSwain); thirty-six miles east of Holbrook, Navajo County, Arizona, September 3, 1930, on *Gutierrezia sarothrae* (P. H. Timberlake); three miles east of Portal, Cochise County, Arizona, September 29, 1955, on *Gutierrezia sarothrae* (P. H. Timberlake); six miles northwest of Pine, Gila County, Arizona, September 17, 1953, on *Gutierrezia microcephala* (P. H. Timberlake); five miles south of Pine, Arizona, September 17, 1953, on *Gutierrezia microcephala* (P. H. Timberlake); near Selegman, Yavapai County, Arizona, September 29, 1931, on *Gutierrezia* sp. (P. H. Timberlake); Yucca Valley, San Bernardino County, California, September 30, 1944, on *Gutierrezia lucida* (P. H. Timberlake); and eight and one-half miles south of Ivanpah, San Bernardino County, California, September 13, 1955, on *Gutierrezia lucida* (C. D. MacNeill). These last have the pronotum more densely pubescent than usual, with a polished median line, perhaps representing a distinct subspecies.

LITERATURE CITED

Clements, F. E. and H. M. Hall. 1923. The phylogenetic method in taxonomy. The North American species of *Artemisia, Chrysothamnus,* and *Atriplex*. Carnegie Institution Washington, Publ. 23.

Craighead, F. C. 1923. North American Cerambycid Larvae. Canada Dept. Agr., Bull. 27 (n.s.), pp. 3-239, pls. 1-44.

Hall, H. M. 1928. The genus Haplopappus. Carnegie Institution Washington Publ. 389.

Knowlton, G. F. 1934. Distributional notes on Utah Coleoptera. Jour. Kansas Ent. Soc. 7:79-86.

Knowlton, G. F. and T. O. Thatcher. 1936. Notes on wood-boring beetles. Utah Acad. Science Arts Letters 13:277-281, fig.

LeConte, J. L. 1851. An attempt to classify the Longicorn Coleoptera of the part of America North of Mexico. Jour. Acad. Nat. Sci. Phila. (2)2:99-112.

Linsley, E. G. 1943. New species of *Crossidius* from Western North America. Ent. News 54:147-149.

——— 1955. Notes and descriptions of some species of *Crossidius*. Pan-Pacific Ent. 31:63-66.

——— 1957. New longicorn beetles from Texas. Ent. News 68:159-161.

——— 1957. New *Crossidius* from California. Jour. Kansas Ent. Soc. 30:42-44.

Wickham, H. F. 1893. Some interesting colour-varieties in the genus *Crossidius*. Canadian Ent. 25:189-194, pl.

FOUR NEW SPECIES OF *ARYTAINA* FROM CALIFORNIA (Homoptera: Psyllidae)

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The four new species of Psyllidae described in this paper breed on wild lilac, *Ceanothus* spp. This genus of plants is the host for more species of *Arytaina* in North America than all other plant groups combined. Host plants of other *Arytaina* species in America are *Cytisus* (introduced from Europe), *Purshia, Amorpha* and *Cercocarpus*.

The species are being described at this time to provide names for use in a separate paper dealing with the parasites of the Psyllidae.

The illustrations on plate I are photomicrographs. Plates II and III are from ink drawings made by Mrs. Celeste Green.

Arytaina mitella, new species
(Pl. I, figs. A-E)

COLORATION. Flavous to dark brown in mature specimens; pale greenish yellow in teneral individuals; apices of antennae and of male forceps black; forewings translucent, veins yellowish.

STRUCTURE. The smaller of the two numbers is for the male and the larger for the female in each of the following pairs. Length to tip of folded wings 2.1 mm.; length of body 1.3-1.6 mm.; length of forewing 1.5-1.9 mm.; width of forewing 0.68-0.8 mm.; width of head 0.45-0.5 mm.; length of antennae 0.55-0.6 mm. *Head* deflexed at approximately 45 degree angle;

vertex 0.17-0.2 mm. long at median suture, relatively smooth with discal foveae only slightly impressed; pubescence absent; postocellar regions moderately raised; genal processes short, 0.07 mm. long, broad, only slightly divergent, apices very broadly rounded. *Forewings* about two and one-half times as long as broad, elongate-ovate in form; pterostigma moderately large.

GENITALIA. *Male:* Proctiger 0.21 mm. long, simple in form; forceps 0.14 mm. long, moderately stout, sides subparallel throughout most of length, convergent distally to a black, blunt or subacute apex; forceps bowed out midway, curving mesad and caudad in distal third. *Female:* Genital segment short, 0.25 mm. long; less than one-third as long as rest of normally distended abdomen; dorso-ventral thickness at base 0.3 mm.; in dorsal view lateral margins of dorsal valve strongly convergent to mid-length then only gradually convergent to form a very broadly rounded apex; in lateral view dorsal valve rounded downward laterally and caudally, appearing somewhat hood-shaped; ventral valve shorter than dorsal, swollen ventrad sub-basally, curving toward dorsal valve apically.

Hosts: Ceanothus divaricatus Nutt.; *C. tomentosus* Parry.

Type locality: Wildwood Canyon, Yucaipa, San Bernardino County, California.

Holotype male (U.S. National Museum), *allotype* female (U.S. National Museum) and 80 paratypes collected on *Ceanothus divaricatus* at the type locality, April 11, 1943 (D. D. Jensen). Additional paratypes from *Ceanothus tomentosus* at the type locality on the same date (D. D. Jensen), from *C. divaricatus* along the highway leading from San Bernardino, California, to Lake Arrowhead, May 10, 1941 (D. D. Jensen), from *Ceanothus* sp. at Las Cruces, April 17, 1950, and Santa Barbara, April 18, 1950, Santa Barbara County, California (D. D. Jensen). Paratypes in the California Academy of Sciences and in the author's collection. Additional specimens, not designated as paratypes, from San Bernardino County, California, as follows: from *Ceanothus divaricatus* at Pine Crest Summit, May 10, 1941 and June 7, 1942 (D. D. Jensen), Mill Creek Canyon May 27, 1941 and May 12, 1943 (D. D. Jensen), Cajon, April 28, 1943 (D. D. Jensen); from *Ceanothus* sp., Oak Glen, May 21, 1941 (D. D. Jensen).

TAXONOMY. *Arytaina mitella* resembles *A. ceanothi* superficially, but is easily distinguished by the more prominent genal processes, the short, blunt, female genital segment and the shorter, caudally curving forceps of the male.

BIOLOGICAL NOTES. Nymphs as well as adults were found on *Ceanothus divaricatus* and *C. tomentosus* at the type locality on April 11, 1943. Floral buds were not yet open on *C. divaricatus,* but *C. tomentosus* was in bloom. Adults were collected with their last instar exuviae as they emerged in the field. They were also reared singly in vials in order to establish their relationship.

The nymphs were particularly abundant on one of several *C. divaricatus* bushes examined, where they were sheltered in young, rolled leaves. One or both margins of the leaves were rolled into the mid-rib on the upper sur-

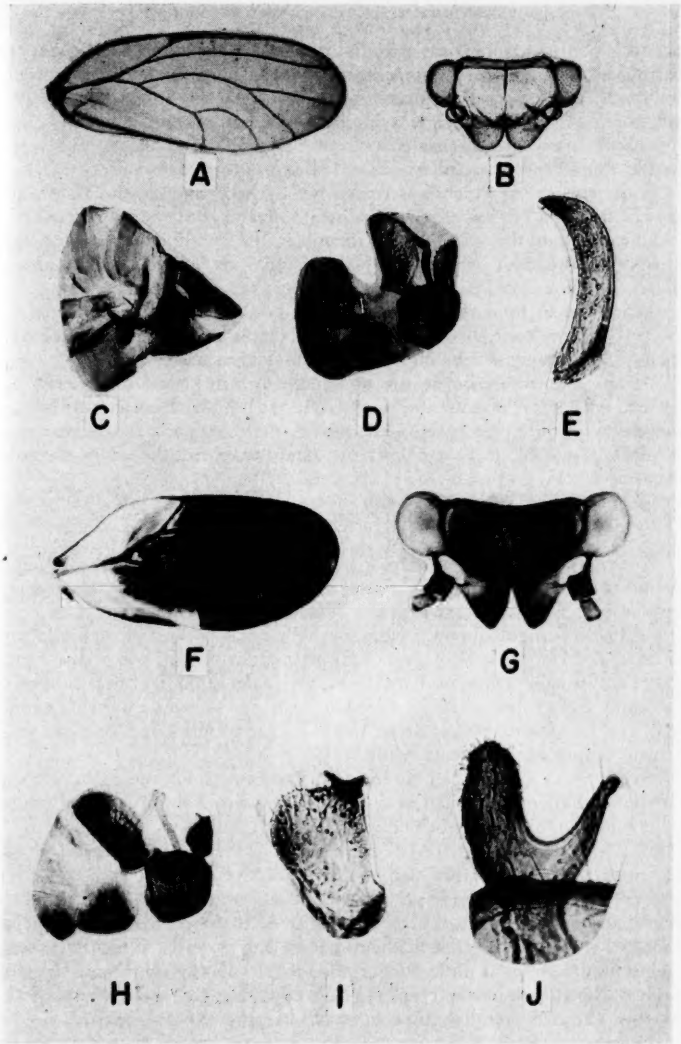

PLATE I

Figures A-E. *Arytaina mitella* new species. A. forewing; B. head; C. female genitalia; D. male genitalia; E. mesal face of male forcep. Figures F-I. *Arytaina essigi* new species. F. forewing; G. head; H. male genitalia; I. outer face of male forcep in ventro-lateral view. Figure J. male forcep of *Arytaina fuscipennis* Crawf. in caudal view.

face. This curling apparently was induced by the feeding of the nymphs, because all rolled leaves contained nymphs and the immature stages were not found except in rolled leaves. The number of last instar nymphs per leaf varied from 10 to 30. The nymphs were naked except for a small mass of cottony, wax threads produced from the caudal end of the abdomen. Liquid excrement persisted in rolled leaves as large, round drops of clear fluid, the surface of which was coated with powdered wax and fragments of wax threads. The rolled condition of the leaves and the moist environment created in the rolls closely resembles the condition caused by the nymphs of *A. bicolor* on *Ceanothus cuneatus* and by the aphid, *Hyalopterus atriplicis* (Linn.) on the leaves of *Chenopodium album* Linn.

When the nymphs are ready to become adults they leave the shelter of the roll and molt for the last time on the outside surface of the rolled leaf or, more commonly, on the under side of an older, unrolled leaf.

Adults are translucent white at emergence later becoming yellow or brown. All of the mature specimens collected in San Bernardino County are yellow or only pale brown. The specimens from Santa Barbara County are dark brown except for a paler area round the base of the wings and pale tan tibiae.

Arytaina essigi, new species
(Pl. I, figs. F-I)

COLORATION. General body color fuscous in mature adults with ivory and flavotestaceous variegation on some individuals. Genal processes usually light except for dark brown apices; antennae dark brown or black over apical half and light brown proximally with distal portion of each segment darkest; anterior margin of pronotum often light brown; meso- and metascutellum usually ivory or light brown; female genitalia fuscous basally, becoming light brown distally. Forewings fuscous to black except for proximal hyaline area extending from radius to pterostigma and through anal area to Cu_2. Posterior tibiae white.

STRUCTURE. The smaller of the two numbers is for the male and the larger for the female in each of the following pairs. Length to tip of folded wings 2-2.7 mm.; length of body 2.4-2.8 mm.; length of forewings 1.7-2.2 mm.; width of forewing 0.9-1.1 mm.; width of head 0.68-.76 mm.; length of antennae 1.4 mm. *Head* deflexed at 45 degree angle or greater; vertex and thoracic nota glabrous or finely punctate; vertex with median suture and discal foveae inconspicuous, the latter often barely discernible; genal processes somewhat pubescent, about half as long as vertex at median suture, length equal to or a little longer than basal width, contiguous basally, slightly divergent, subacute apically. *Forewing* length about twice width, broadly rounded apically, subcoriaceous; pterostigma very small.

GENITALIA. *Male:* Proctiger 0.3 mm. long, pubescent, posterior margin gently rounded from base to apex; forceps half as long as proctiger, broad in lateral view, pubescent; apex bifid with one anteriorly and one posteriorly projecting acute tooth, the anterior tooth being more slender and a little longer than the posterior; posterior margin of forceps approximately vertical, anterolateral margin strongly convex; in caudal view forceps bowed

out in middle portion. *Female:* Genital segment about half as long as balance of normally distended abdomen, sparsely pubescent; ventral valve half as long as dorsal, truncate, not notched; length of anal opening nearly half as long as dorsal valve which, in profile, descends almost vertically just caudad from circum-anal ring, then tapers gradually to subacute apex.

Hosts: Ceanothus tomentosus Parry, *C. divaricatus* Nutt., *C. papillosus* T. & G., *C. crassifolius* Torr.

Type locality: San Timoteo Canyon-Moreno Valley Road, Riverside County.

Holotype male (U. S. Nat'l. Museum), *allotype* female (U. S. Nat'l. Museum) and 54 paratypes collected by D. D. Jensen on *Ceanothus tomentosus* var. *olivaceous,* San Timoteo Canyon-Moreno Valley Road, Riverside County, California, March 23, 1941. Twenty-four additional paratypes collected on the same host at the same locality March 16, 1942, and 31 from *C. divaricatus,* Pine Crest Summit, San Bernardino Mountains, San Bernardino County, California, May 10, 1941 (Jensen).

Additional California material, not designated as paratypes, as follows: from *Ceanothus tomentosus* at the type locality April 15, 1940, May 29, 1941, January 30, February 10, March 31, 1942, February 26, 1943 (nymphs and adults), and May 13, 1944, and at same locality on *C. crassifolius,* April 20, 1941 (Jensen). Adults from *C. divaricatus* at Pine Crest Summit, San Bernardino County, June 7, 1942 (Jensen). Adults and nymphs from *C. tomentosus,* Mill Creek Canyon, San Bernardino County, March 12, 1943 (Jensen). One male from *C. tomentosus,* Live Oak Canyon, San Bernardino County, April 16, 1939 (P. H. Timberlake). One female from same host near Rainbow, San Diego County, April 12, 1942 (Jensen). One female and 2 males, San Gabriel Camp, Los Angeles County, April 15, 1939 (R. M. Bohart). One female from Santa Barbara, April 18, 1950 (Jensen). Adults and nymphs from *Ceanothus papillosus,* Cone Peak, Santa Lucia Mountains, Monterey County, April 15, 1923 (G. F. Ferris). (This record was published previously by Klyver (1932) under the name *Arytaina fuscipennis* Crawford.)

This distinctive species is named in honor of Professor E. O. Essig, University of California, to whom the writer is deeply indebted for many years of valuable and enjoyable association.

TAXONOMY: This species is very closely related to *Arytaina fuscipennis* Crawford (Pl. I, fig. J), but the male forceps and female ventral valve are strikingly distinct. It is also smaller and the wing coloration is somewhat different.

BIOLOGICAL NOTES. On February 26, 1943, nymphs as well as adults were found on *Ceanothus tomentosus* at the type locality. The first nymphs found were crawling up a branch, apparently to transform into adults. Also, a few young nymphs were found above ground where they were concealed under the bark where a large branch had been scarred. Twenty nymphs, of several instars, were found at ground level on the main branch where there was a sheltering depression in the branch. On other bushes, nymphs were found in larger numbers. None of these was found above ground, but they oc-

curred in groups on the main branches, just below the surface of the soil in the region of root attachment.

Near the mouth of Mill Creek Canyon, San Bernardino County, California, March 6, 1943, many nymphs were found on several bushes of *Ceanothus tomentosus* which were just beginning to bloom. Nymphs occurred around the crown of the plants a few inches below the soil surface.

The nymphs are predominantly dark brown but produce a white, anal wax tube which is sometimes slender and in other cases is inflated. Wax filaments are also produced from the circum-anal area. The bodies of the nymphs frequently carry scattered fragments of wax which are probably acquired as the nymphs move about through the wax secretions.

Single nymphs were caged in vials with the pieces of bark on which they were feeding or with woody twigs, and adults of *essigi* emerged from several of these.

Parasites reared from the nymphs of *A. essigi* are reported in a separate paper (Jensen, in press).

Arytaina boharti, new species
(Pl. II, figs. A-E)

COLORATION. *Male:* Fuscous on body except testaceous on tibiae, thorax around wing attachment, basal two-thirds of antennae and compound eyes; ocelli rufescent. *Forewings* with variable dark brown to black maculation, darkest in distal portion of wing between Cu_2 and radial sector, extending proximally to coalescence of media and cubitus; a dark patch in fork of basal vein and another between cubital petiole (M+C) and claval suture; a narrow lighter band along each side of wing veins. Hind wing with dark anal area. *Female:* General body coloration variegated, ranging from ivory and flavous to tan and fuscous; vertex, pronotum, prescutum (except cephalic median area), a median band on scutum, and an area around wing attachment lighter in color than most of abdomen, the genal processes, and remainder of thorax.

STRUCTURE. The smaller number is for the male and the larger for the female in each of the following pairs. Length to tip of folded wings 2.00-2.21 mm.; length of body 1.8-2.38 mm.; length of forewing 1.6-1.9 mm.; width of forewing 0.75-0.87 mm.; width of head 0.55-0.59 mm.; vertex at median suture 0.21 mm.; length of antennae 0.68-0.76 mm. *Head* deflexed at about 45 degree angle; vertex bulging on each side of median suture in cephalic half with a broad, discoidal fovea on each side of median suture near posterior margin of vertex; genal processes one-third length of vertex at median suture, broadly rounded, usually contiguous basally. Head and thorax without pubescence. *Forewings* about twice as long as broad; pterostigma moderate in size. Hind tibia with 4 black apical spines, 1 on outside and 3 on inside margin.

GENITALIA. *Male:* Proctiger simple in form, approximately 0.25 mm. long. Forceps 0.17 mm. long; in lateral view caudal margin straight to apex; cephalic margin straight in basal half then gradually curving caudad and mesad to small black apex directed mesad. *Female:* Dorsal valve 0.58 mm.

long, approximately one-third length of normally distended abdomen without cauda. Terminalia large in basal third, then narrowed sharply, caudal half acuminate; dorsal valve longer than ventral, styliform, acute; ventral valve styliform, acute in caudal third.

Host: Ceanothus cuneatus (Hook.) Nuttall.

Type locality: Fifteen miles northwest of Ojai, Ventura County, California.

Holotype female: (California Acad. Sci.), *allotype* male (California Acad. Sci.), 31 female and 54 male paratypes collected by D. D. Jensen from *Ceanothus cuneatus* at the type locality April 19, 1950. Two male and 2 female paratypes from *Ceanothus* sp., Santa Monica Hills, Calif., April 18, 1939 (R. M. Bohart). Paratypes in the U. S. National Museum and in the author's collection. Two additional females, not designated as paratypes, are at hand. One, in the California Academy of Sciences, was collected in San Diego County, California, May 3, 1913 (E. P. Van Duzee). The other female was collected from *Ceanothus cuneatus* at Bear Creek Lodge, Mariposa County, California, on the highway between Merced and Yosemite National Park, June 1, 1947 (D. D. Jensen).

This species is named for Dr. R. M. Bohart in whose collection of Psyllidae the species was first seen by the writer. A search for additional specimens was successful near Ojai.

TAXONOMY. *Arytaina boharti* appears to be closely related to *A. bicolor* but differs markedly in the form of the female genitalia. Other less conspicuous differences occur in the male forceps, in gross size, and in the more variable wing pattern of *A. boharti*. The female genitalia of *A. boharti* are more similar to those of *A. aculeata* Crawford than to any other American species in the genus. However, *A. aculeata* bears little other similarity to *A. boharti* and breeds on *Cercocarpus* sp.

Arytaina bicolor, new species

(Pl. III, figs. A-E)

COLORATION. *Male:* Fuscous over body and wings except as follows: ocelli rufescent, compound eyes light grey on dry specimen, antennae pale tan in basal two-thirds, tibiae and tarsi tan, forewings translucent in basal area and along claval suture; hind wings dark in anal area and along veins, otherwise translucent. *Female:* General body coloration ranges from pale bluish-green to flavotestaceous; antennae dark in distal one-third; ocelli rufescent. Forewings pale amber, becoming fumate on mature specimens, particularly in distal region; punctate to rugulose; translucent to opaque.

STRUCTURE. The smaller of the two numbers is for the male and the larger for the female in each of the following pairs. Length to tip of folded wings 2.00-2.38 mm.; length of body 1.7-1.85 mm.; length of forewing 1.7-1.87 mm.; width of forewing 0.84-0.93 mm.; width of head 0.59-0.63 mm.; vertex at median suture 0.17-0.22 mm.; length of antennae 0.7 mm. *Head* deflexed at about 45 degree angle; vertex bulging on each side of median suture in cephalic half with a broad, discoidal fovea on each side of median suture near posterior margin of vertex; genal processes almost

½ length of vertex, broadly rounded apically, not contiguous. Head and thorax smooth, shiny. *Forewings* about twice as long as broad; pterostigma moderate in size. Hind tibia with black apical spines, 1 on outside and 3 on inside margin.

GENITALIA. *Male:* Proctiger simple in form, 0.25 mm. long. Forceps 0.2 mm. long, in lateral view tapering gradually to a small, acute black apical tooth directed meso-cephalad. *Female:* Dorsal valve 0.34 mm. long, one-half length of normally distended abdomen without cauda, tapering to bluntly rounded, slightly upturned apex. Circum-anal pore ring circular in outline, diameter three-eighths length of total dorsal valve. Ventral valve three-fourths length of dorsal, acute apically.

Host: Ceanothus cuneatus (Hook.) Nuttall.

Type locality: Rock City Camp, Mt. Diablo, Contra Costa County, California.

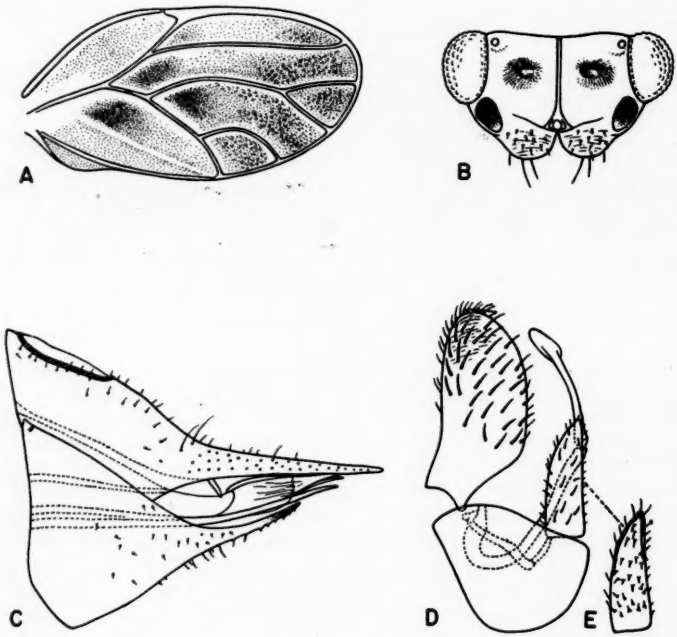

PLATE II

Figures A-E. *Arytaina boharti* new species. A. male forewing; B. head; C. female genitalia; D. male genitalia; E. mesal face of male forcep.

Holotype female (Calif. Acad. Sci.), *allotype* male and 100 paratypes collected by D. D. Jensen from *Ceanothus cuneatus* at the type locality May 25, 1949. Forty-eight additional paratypes from the same host and locality, May 18, 1947 (Jensen). Paratypes in the U. S. National Museum and in the author's collection.

TAXONOMY. *Arytaina bicolor* has obvious affinities with *A. boharti* but is conspicuously different in the form of the female genitalia and to a lesser extent in the form of male forceps and gross body size.

BIOLOGICAL NOTES. The following observations were made at the type locality, May 25, 1949, where adults were emerging in large numbers. The nymphs are dark brown on the sclerotic portions with the membranous areas whitish. (In living nymphs the body fluids impart a bluish-green color to much of the abdomen.) Ten nymphs were caged singly in vials and reared to the adult stage, thus definitely establishing their relationship.

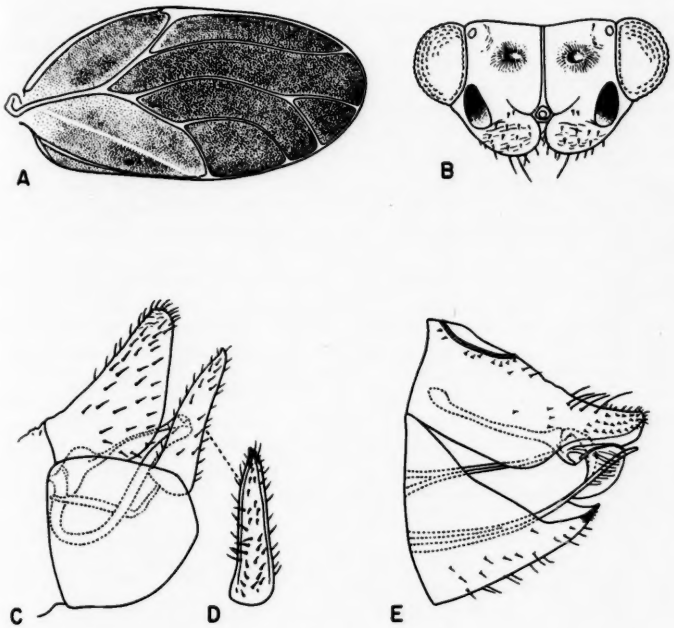

PLATE III

Figures A-E. *Arytaina bicolor* new species. A. male forewing; B. head; C. male genitalia; D. mesal face of male forcep; E. female genitalia.

The nymphs were found concealed by malformed leaves which had rolled upward and inward as a result of the nymphal feeding. Sometimes only one margin of the leaf was rolled while in other cases both sides were rolled, either overlapping or meeting along the midrib. Usually only one or two leaves of a fascicle were infested. At most, less than 5 per cent of the leaves were infested and they were usually widely scattered.

The feeding of the nymphs also caused the leaves to be chlorotic and smaller than normal. This effect was local and did not appear to influence the growth of non-infested leaves of the same fascicle.

The nymphs apparently extract considerable fluid from the host leaves. The excreted liquid is clear and adheres to the cauda as large globules. As it is produced, the excrement is coated with longitudinally striated wax. In addition to this wax, many long, slender wax threads are produced from the circum-anal region. Some of these break up and also contribute to the wax layer surrounding the liquid. This white to pale yellow wax surface is effective in preventing the leaf surface and the nymphs from becoming wet. Since the nymphs feed in rolled leaves, evaporation is slow and the liquid often accumulates in masses as large as 2.00-3.5 mm. in length. Nymphs feed in the presence of these liquid globules without becoming wet. However, if the globule is broken the leaf and the nymphs become flooded with liquid. The wax threads also gradually accumulate to form a mass of cotton-like wax. In some leaves a sooty mold fungus had developed on the waxy mass, but without apparent adverse effects on the nymphs which were feeding beneath the mass.

Most of the nymphs inhabiting the rolled leaves were in their last instar. Only a few younger nymphs were found. Before becoming adults the nymphs leave the rolled leaf and crawl to the underside of another leaf. There the molt occurs leaving the cast skin attached to the leaf.

Nearly all of the rolled leaves had eggs laid on the outside surface and a few of these were hatching. These eggs were presumably laid by the recently emerged adults and constitute a second brood of the species. However, adults of *A. ceanothi* Crawford and a species near *A. minuta* Crawford were also on the host bush, so the specific identity of the eggs is uncertain. The eggs are typical of others in the Psylline group being pear shaped and attached to the leaf surface by a small stipe near the large end.

One rolled leaf contained many nymphs which apparently had been killed by a syrphid fly larva which was present. Parasites reared from nymphs of *A. bicolor* are recorded in a separate paper (Jensen, in press).

LITERATURE CITED

Jensen, D. D. 1957. Parasites of the Psyllidae. Hilgardia (in press).

Klyver, F. D. 1932. Biological notes and new records of North American Chermidae (Homoptera). Ent. News 43:7-12; 33-40; 70-75.

MORPHOLOGY OF THE HEAD OF A SAWFLY, *MACROPHYA PLURICINCTA* NORTON (Hymenoptera, Tenthredinidae)[1]

RYUICHI MATSUDA

The present study was undertaken primarily in an attempt to give basic comparative anatomical data for the understanding of the morphology of the heads of higher groups of Hymenoptera. While the heads of a few species of higher groups of Hymenoptera have been investigated in sufficient anatomical detail, Taylor's work (1931) on the heads of four species of Tenthredinidae is far from complete and seems to be inaccurate in its details, and Takeuchi and Tokunaga's work on the external morphology of *Nipponorhynchus mirabilis* (1941) deals with an extremely highly specialized group of Tenthredinidae. These works, therefore, cannot be reliable sources for the morphological understanding of the heads of higher Hymenoptera.

The present work also aims at testing some theories in regard to the morphology of the facial region of the insect head which have been advanced recently by Duporte (1946, 1956), Duporte and Bigelow (1952), Bigelow (1954), Snodgrass (1947), and Matsuda (1956), using *Macrophya pluricincta* Norton which belongs to a primitive family of the Hymenoptera, the Tenthredinidae.

Snodgrass' work on the honeybee (1942) and Duncan's work (1939) on *Vespula pennsylvanica* were referred to in an attempt to see the structural differences between the heads of the Tenthredinidae and higher groups of Hymenoptera. In the following pages *Apis* refers to *Apis mellifera* Linnaeus studied by Snodgrass, *Vespula* refers to the species studied by Duncan, and *Macrophya* refers to the species treated in this work.

The writer wishes to express his sincere thanks to Dr. Charles D. Michener for his valuable criticisms and suggestions in preparing the manuscript, and to Dr. Robert E. Beer for the identification of specimens.

THE LABRUM (Pl. I, B, C; Pl. II, E)

The labrum is a flattened, transverse and rather thin plate; its ventral surface is membranous, its basal area is also membranous and hidden beneath the anterior region of the clypeus. The epipharynx is continuous from the ventral upper region of the labrum, largely membranous, but with well defined marginal sclerites. The anterior cibarial wall is formed by the epipharynx. Paired apodemes supporting the stomodaeum laterally are articulated with the sclerotized marginal area of the epipharynx, the base of each apodeme being clearly free from the hypopharynx. The apodeme supporting the stomodaeum is articulated with the sclerite of the hypopharynx in some pterygote orders.

Muscles of the labrum: The muscles of the cibarium (3,4) arising from the upper anterior surface of the labrum are inserted on the epipharynx and

[1] Contribution No. 951 from the Department of Entomology, University of Kansas.

beneath the lower end of the epipharynx respectively. The epipharynx also receives an unpaired median labral muscle (1) arising from the frontal region beneath the anterior ocellus above the stomodaeum, and paired lateral muscles (2) arising from the same horizontal plane as the extrinsic median labral muscle on the frons. In *Apis,* the retractor or levator of the epipharynx, the homologue of muscles 3, 4 in *Macrophya,* arises on the distal part of the clypeus.

THE CLYPEUS (Pl. I B; Pl. II, A, E)

The anterior region of the clypeus overhangs the basal region of the labrum and is continuous with the latter by a membranous region of the labrum. The fronto-clypeal suture is obscured medially. The point of origin of the anterior tentorium is rather strongly depressed and located just beneath the antennal cavity. In the absence of distinct frontogenal and frontoclypeal sutures the point of origin of the anterior tentorium cannot be related clearly with a particular suture.

Muscles of the clypeus: The only muscles arising from the clypeus (5, 6, 7, 8) are attached on the stomodaeum. In *Apis* there is a retractor, or levator, of the epipharynx which is inserted within a palatal region; this is the homologue of the muscles 3, 4 arising from the labrum in *Macrophya* as stated previously; five other muscles arising from the clypeus in *Apis* insert on the anterior wall of cibarial region of the sucking pump.

THE FACIAL REGION AND THE TENTORIUM (Pl. I, B)

The frontoclypeal suture is rather obscurely defined and goes straight across between the bases of the mandibles. The antennal cavity is closely approximated to the frontoclypeal suture. The frontogenal suture is represented by a short obscure line leading dorsally to the lateral margin of the antennal cavity from the dorsolateral angle of the clypeus. There is no trace of the ecdyseal line on the dorsal part of the face. Three ocelli are present. The compound eye is large, ventrally approximate to the side of the mandible. The anterior tentorium arises from the lateral region of the frontoclypeal suture along the ill-defined frontogenal suture and obliquely extends backwards forming a straight and composite bar with the posterior tentorium which arises from the posterior tentorial pit on the postoccipital suture. The boundary between the anterior and posterior tentorial arms is thus impossible to define, but the indication obtained from the muscle attachment to this composite bar is that the bar dorsally is composed chiefly of the anterior tentorial element and ventrally is mainly posterior tentorial in origin, as will be discussed later. The dorsal arm of the tentorium, which is known to be the outgrowth from the anterior tentorial arm, is a robust, long and straight arm arising near the point of origin of the definitive posterior tentorial arm. It is firmly fused to the frons considerably above the anntenal cavity. In *Apis* the dorsal arm of the tentorium is a weak and delicate structure. The condition seen in *Macrophya* seems to be secondary.

In regard to the point of origin of the tentorium, Duporte (1946, 1953) and Duporte and Bigelow (1952) claim that the anterior tentorium primitively lies on the frontogenal suture, not on the frontoclypeal or the episto-

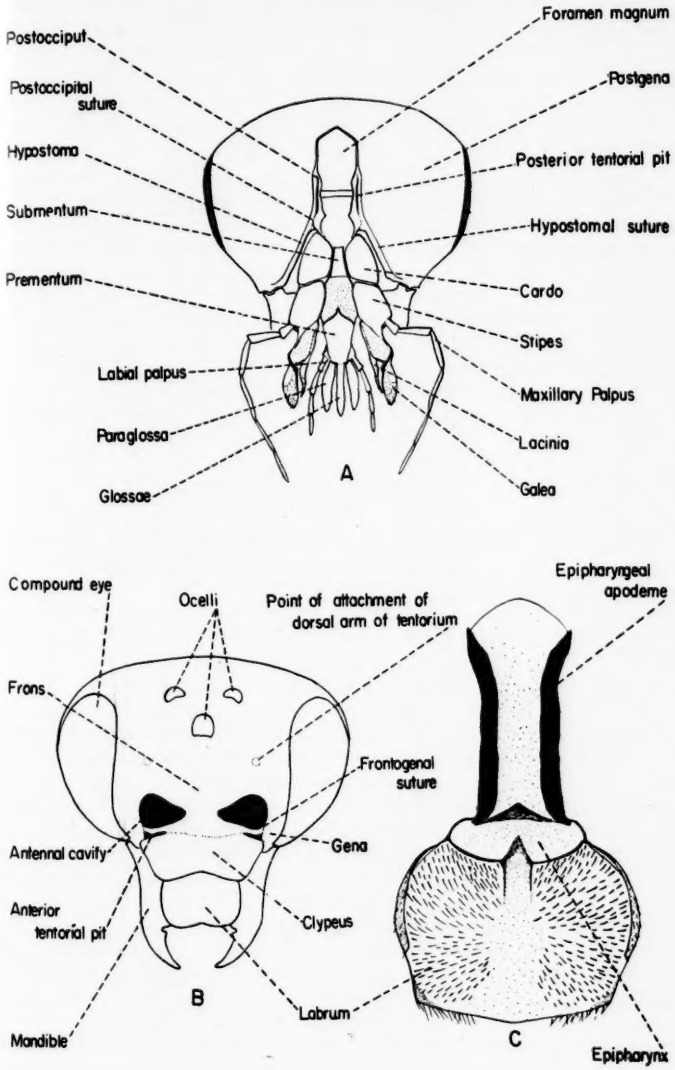

PLATE I

A. Ventral side of the head. B. Dorsal side of the head. C. The labrum.

mal suture as is generally believed. They further think that the dorsal shift of the anterior tentorial arm is on this suture, accompanied by the development of the genal and postgenal regions above the mandible. In the species treated in this work the anterior tentorium arises topographically from the primitive point of origin in the insect head suggested by Duporte and Bigelow (1953), but the exact point of origin cannot be related with a particular suture, as was indicated earlier in this paper.

Duporte's theory seems to indicate an essential concordance with the view expressed by Matsuda (1956) in regard to the origin of the anterior tentorium. He thinks that the anterior tentorium is the intersegmental invagination between the mandibular and antennocular segments based on the embryological evidence and the muscle attachment to this structure in primitive groups of pterygote insects. If Duporte's theory is correct, the anterior tentorium can be interpreted as being associated with both the mandibular and antennocular segments, since the gena, at least ventrally, can be a part of the mandibular segment and the frons is a part of the antennocular segment. The anterior tentorial pit, whatsoever facial position it takes, thus may represent the superficial point of boundary between the mandibular and the antennocular segments.

THE MUSCULATURE OF THE ANTENNA AND THE STOMODAEUM (Pl. II, A, E; Pl. III, E)

In *Macrophya* three extrinsic muscles (19, 20, 21) arise from the lower part of the dorsal arm and upper portion of the composite tentorial bar. In *Apis* four extrinsic muscles of the antenna arise from the anterior tentorial arm. In *Vespula* there are also present four extrinsic muscles. Two muscles of the flagellum (22, 23) occur in *Macrophya:* the same number of muscles of the flagellum occur in *Apis.*

In *Macrophya* four bundles of muscle fibers (5, 6, 7, 8) arising from the clypeus insert on the stomodaeum near its apex; in *Apis* the homologues are represented by five bundles of muscle fibers as was noted previously. Two muscles (9, 10) arising from the frons beneath the anterior ocellus insert on the upper extremity of the pharyngeal region of the stomodaeum inside the tip of the epipharyngeal apodeme; one muscle (11) of the stomodaeum arising from the frons originates beneath the points of origin of the preceding muscles; in *Apis* also three muscles arising from the frons insert on the pharyngeal region of the stomodaeum. One muscle (12) arising from the base of the anterior tentorium goes upwards to insert on the upper extremity of the phryngeal region; this muscle arises from the base of the anterior tentorium also in *Apis.* One thick muscle (14) arising from the tentorial bridge inserts on the ventral side of the oesophageal region; this is lacking in *Apis.* One slender muscle (15) arising from the vertex and inserting on the dorsal side of the oesophageal region is probably the homologue of the postcerebral muscle of the pharynx in *Apis.* One thick muscle (13) arising from the tentorial bridge is inserted on the ventral upper extremity of the pharyngeal region. Snodgrass' compressor of the suctorium (31) in *Apis* is lacking in *Macrophya.*

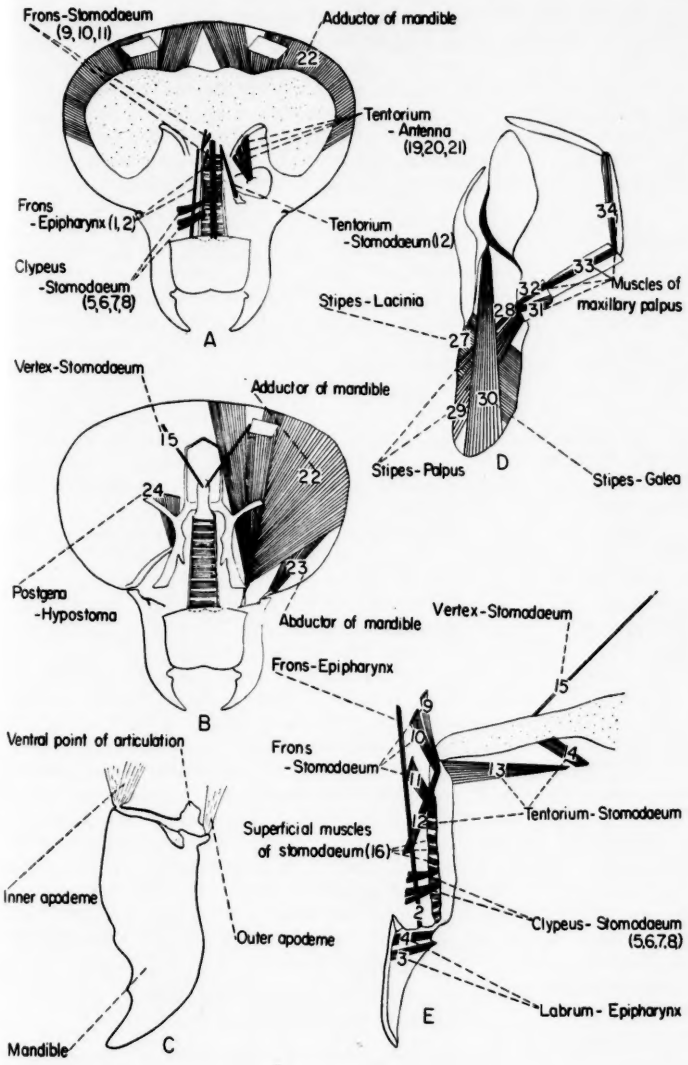

PLATE II

A, B. Dorsal side of the head showing the musculature. C. The mandible. D. Muscles of the maxilla. E. Muscles of the cibarium and the stomodaeum.

Snodgrass (1947) believes that the muscles of clypeus and those of the frons are invariably separated by the frontal ganglion, which always marks the dividing line between the undersurface of the preoral clypeus and postoral part of the head. Duporte (1956), accepting this criterion, further points out that the anterior tentorial arms are at approximately the same level as the frontal ganglion. These criteria were found to hold up in another species of Tenthredinidae dissected. The frontal ganglion was found to be located at the position suggested by Snodgrass and Duporte.

THE GNATHAL SEGMENTS (Pl. I, A; Pl. II, C; Pl. III, A, B, C, D, F)

The mandible: The mandible is well developed, with two blunt teeth on the inner margin; the anterior and posterior articulation are on about the same horizontal plane with the ill-defined frontoclypeal suture. Dorsally the mandible is articulated with the basal lateral angle of the clypeus, ventrally the mandible is articulated with the hypostomal thickening by a condyle. The abductor apodeme for the muscles arises laterally between the dorsal and ventral articulations; the larger abductor apodeme arises from the upper inner angle of the mandible. The hypostomal thickening begins from the ventral point of articulation of the mandible, going dorsally to a point beneath the posterior tentorial pit. There is no formation of the subforaminal bridge seen in higher groups of Hymenoptera. The postgena is very broad, occupying the area lateral to the hypostomal suture.

The maxilla: The maxillary cardo is articulated with the postocciput. The postoccipital suture is not well defined but is represented by a longitudinally depressed area in which the posterior tentorial pit lies. The maxillary stipes is long, continuous with the cardo by a narrow membranous area, and bears the six-segmented palpus laterally. The galea is basally well defined by a well sclerotized area. The lacinia is elongate, flap shaped.

The labium: The submentum is elongate, closely approximate laterally to the maxillary cardo at base. The prementum is represented by a single plate, separated from the submentum by a membranous region; the base of the prementum is strongly sclerotized and thick, acutely produced posteriorly into the membrane ventrally. Dorsally the prementum is membranous and is continuous with the epipharynx. This dorsal membranous area is labelled the hypopharynx, since the salivary duct arises from the base of the glossa, anterior part of this membranous region. The hypopharynx forms the posterior wall of the cibarium. The palpus is four-segmented. The glossa and the paraglossa are clearly separated. The paraglossa is provided with a distinct transverse carina on the ventral surface at the base for the muscle attachment. The glossae are fused, represented by a single lobe, strongly sclerotized basally for muscle attachment.

THE MUSCULATURE OF THE GNATHAL SEGMENTS (Pl. II, D; Pl. III, A, B, C, D, F)

Muscles of the mandibular segment: A huge mass of the adductor muscle of the mandible (22) arises from the cranium behind the brain and is inserted on the inner mandibular apodeme; usually six bundles of muscle fibers are recognized dorsally. The abductor muscle of the mandible (23)

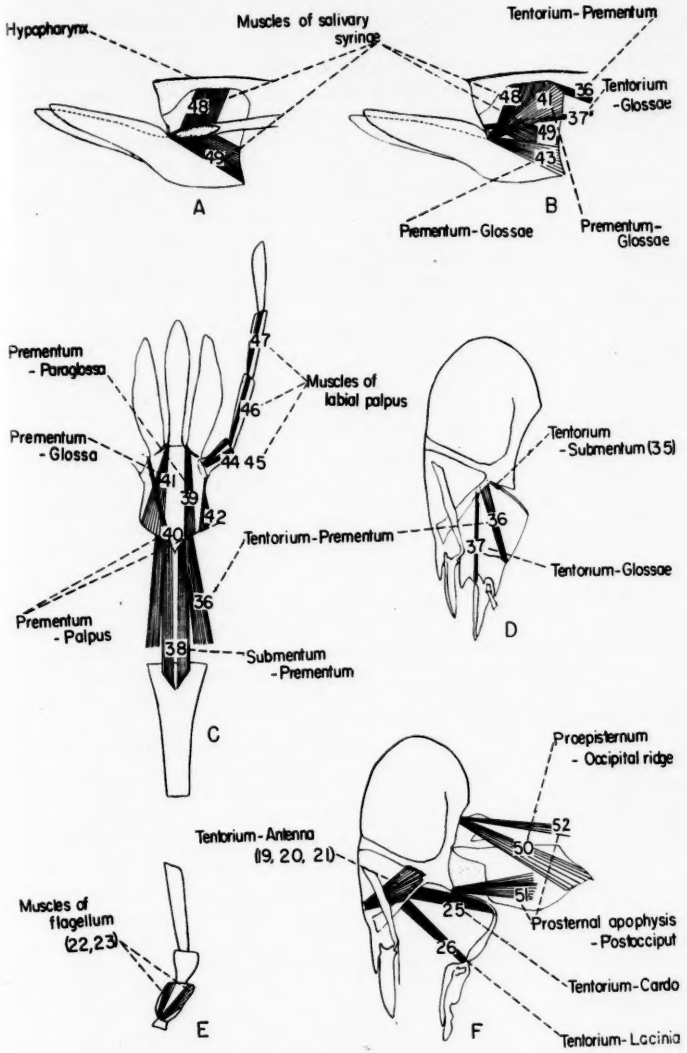

PLATE III

A. Muscles of the salivary syringe. B. Muscles of the hypopharynx and labial segment. C, D. Muscles of the labium. E. Muscles of the antennal flagellum. F. Muscles of the antenna, maxilla and the hind region of head.

arises from the dorsolateral region of the cranium above the compound eyes and is inserted on the outer mandibular apodeme. No muscle from the tentorium is inserted on the mandible. There is also a small fan-shaped muscle (24) arising from the postgena along the lateral margin of the foramen magnum; this muscle is inserted on the point of the union between the hypostoma and the tentorium. The last mentioned muscle is lacking in *Apis*.

Extrinsic muscles of the maxillary segment: There are two extrinsic muscles (25, 26) coming from the ventral side of the composite tentorial bar, the anterior one of them inserts on the base of the lacinia, the posterior one goes horizontally to insert on the almost entire cardo. In *Apis* three muscles arising from the extreme anterior end of the anterior tentorial arm insert on the base of the stipes.

Extrinsic muscles of the labial segment: There are three extrinsic muscles of the labium in *Macrophya;* the one (36) arising from the hindmost part of the tentorium (tentorial body) is inserted on the posterolateral angle of the prementum; another slender one (37) extends from the tentorium anterior to the point of origin of the preceding muscle and is inserted on the dorsal sclerotized part of the glossa at the base near the salivary opening; the last one (35) arises from behind muscle 36 on the tentorial body and is inserted on the base of the submentum. In *Apis* the anterior adductor of the labium arises from the dorsal wall of the cranium (homologue of 36), and the posterior one arises from the anterior end of the anterior tentorium. No homologue of the muscle 34 occurs in *Apis*.

It is interesting to point out the shift of origins of the extrinsic muscles in *Apis*. In *Macrophya* the two extrinsic muscles of the labium arise from the tentorial body and from near the tentorial body, and two extrinsic muscles of the maxilla arise from the ventral side of the composite tentorial bar anterior to the origins of the preceding muscles, maintaining primitive points of origins of these muscles, whereas, in *Apis,* three extrinsic muscles of the maxilla and one extrinsic muscle of the labium arise from the anterior part of the anterior tentorium. This is apparently the secondary shift of origins of the muscles in this highly specialized species of Hymenoptera. The points of origin of the maxillary and labial muscles in *Macrophya* very likely represent the original posterior tentorial region in this composite tentorial bar and the points of origin of these muscles in *Apis* have apparently resulted from the anterior shift of the muscles. The same tendency is seen in *Vespula.* According to Duncan (1939) the posterior labial adductor and three extrinsic fan shaped muscles of the maxilla arise from the dorsolateral part of the clypeus, the region which is also suspected to be the extreme anterior portion of the anterior tentorial arm. The origin of the anterior adductor muscle of the labium from the cranium in *Apis* and one of promotor muscle of the maxilla from the postgenal inflection in *Apis* also seem to be secondary shifts from the primitive points of origin on the tentorium, as was pointed out by Snodgrass (1935, 1942).

It should also be noted that the extrinsic muscles of the labium and maxilla arise from the ventral side of the tentorial bar, and the muscles of

the antenna arise dorsally from the bar and from the base of the dorsal arm of the tentorium; this muscular arrangement seems to indicate that the tentorium is ventrally largely posterior tentorial, and dorsally anterior tentorial in origins.

Intrinsic muscles of the maxillary segment: The muscle of the galea (30) arises from the basal margin of the stipes and is inserted on the small heavily sclerotized area of the galea. The muscles of the palpus (28, 29) are represented by two distinct bundles of muscle fibers; each arises from the basal inner margin of the stipes, of which the anterior small one (28) is inserted on the upper basal margin of the first palpal segment, the posterior thicker one (29) inserts on the base of the first palpal segment. Another broad muscle (27) arises from the outer margin of the stipes, spreads obliquely to be inserted on the inner margin of the stipes and the basal cavity of the lacinia. In the first palpal segment two antagonistic muscles (31, 32) are recognized, the second and third ones each provided with a single bundle of muscle fibers (33, 34). The presence of muscle fibers of the fourth to sixth segment was not confirmed.

In *Apis* the muscle of the galea (homologue of 30) is inserted by a long tendon laterally on the base of the galea; the muscle of the maxillary palpus is represented by a single bundle of muscle fibers; the muscle of the lacinia is the same in origin and insertion as in *Macrophya.* In *Vespula,* according to Duncan, the muscle of the palpus is represented by two bundles of muscle fibers, and the muscles of the galea and lacinia originate in the proximal half of the stipes.

Intrinsic muscles of the labial segment: One muscle (39) arising from the basal region of the prementum is inserted on the small transverse sclerite at the base of the paraglossa. Dorsal to this from the middle of the basal margin of the prementum there arises a slender muscle (40) which is inserted on the upper margin of the first palpal segment. Lateral to the muscle of the paraglossa (39) there arises a bundle of muscle fibers (42) from the posterolateral angle of the ventral side of the prementum; this muscle is inserted on the basal part of the membranous region surrounding the base of the first palpal segment. Two intrinsic muscles (41, 43) arising respectively from the ventral posterolateral margin and the dorsal posterolateral margin of the prementum are inserted on the carinated area at the base of the glossa. Two thin muscles (48, 49) arising from the dorsal and ventral walls of the prementum are inserted on the basal region of the salivary duct. Two antagonistic muscles (44, 45) in the first palpal segment and one muscle in the second and third segments (46, 47) were found in this study. In *Apis* the premental retractor of the ligula is probably the homologue of muscle 39. The flexor of the glossa is homologous to muscles 41, 43 in *Macrophya.* Only one muscle of the labial palpus is present in *Apis* and *Vespula.* The muscles of the salivary syringe, in *Apis,* are represented by dilator and compressor muscles; they are the dilator of the salivarium and the posterior muscle of the salivarium in *Vespula.*

Muscles inserted on the hind region of the head: One muscle (50) arising from the pre-episternum goes obliquely to be inserted on the upper lateral

angle of the foramen magnum. One muscle (51) arising from the sternal apophysis of the prothorax inserts beneath the posterior tentorial pit. Another muscle (52) arising from the tip of the sternal apophysis is inserted on the foramen magnum just above the point of insertion of muscle 50. In *Apis,* in addition to the pleural levator, there are two muscles from the endosternum to the tendon attached to the foramen magnum and two muscles arising laterally on the prephragma of the mesonotum to insert on the dorsal angle of the foramen magnum. In *Macrophya,* the dorsal muscle which usually extends between the phragma of the mesonotum and the posterior tentorium or the foramen magnum in other orders of insects and *Apis,* is probably functionally substituted by muscle 52. Due to strong reduction and membranization of the protergum the dorsal muscle has been apparently lost.

LITERATURE CITED

Bigelow, R. 1954. Morphology of the face in the Hymenoptera. Canad. Jour. Zool. 32: 378-392.

Duporte, E. 1946. Observation on the morphology of the face in insects. Jour. Morph. 79:371-417.

——— 1953. The protocephalon: A critique of recent interpretation. Canad. Ent. 85: 41-55.

——— 1956. The median facial sclerite in larval and adult Lepidoptera. Proc. Roy. Ent. Soc. Lond. (A) 31:109-116.

——— and Bigelow, R. 1953. The clypeus and the epistomal suture in Hymenoptera. Canad. Jour. Zool. 31:20-29.

Duncan, C. 1939. A contribution to the biology of North American Vespine wasps. Stanford Univ. Pub. Biol. Sci. 8:1-272.

Matsuda, R. 1956. The musculature of the head of *Agulla adnixa* (Hagen). Jour. Kans. Ent. Soc. 29:146-155.

Snodgrass, R. 1935. Principles of insect morphology. McGraw-Hill. New York. x + 1-667.

——— 1942. The skeleto-muscular mechanisms of the honey bee. Smiths. Misc. Coll. 103:1-120.

Takeuchi, K. and Tokunaga, M. 1941. Morphological study of head and mouthparts of a remarkable sawfly, *Nipponorhynchus mirabilis* Takeuchi. Tenthredo 3:275-291.

Taylor, E. 1931. The morphology of Tenthredinid heads. Proc. Roy. Phys. Soc. Edinburgh 22:41-70.

RECORDS OF WESTERN ODONATA WITH NOTES ON *AMPHIAGRION ABBREVIATUM* (Selys)

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University of Michigan, Ann Arbor

The paucity of published data on geographical distribution of Odonata in western United States is well recognized by students of the group. The following account is based on two series of collections in June and August, 1955, made respectively by Dr. Roland L. Fischer, William Drew and Ronald W. Hodges, of Michigan State University and deposited there, and by the author and his wife and deposited in the Williamson-Kennedy collection of the University of Michigan. According to the published literature

on the specific distribution of the species here treated we recognize in our data fifteen state records.

NEBRASKA:

Cherry Co., Sand Hills region, 5 mi. S.E. of Valentine, Aug. 1, 1955, E. J. and P. H. Kormondy.

Libellula pulchella Drury, ♂.

Sympetrum (Tarnetrum) corruptum (Hagen), ♂.

Sympetrum internum Montg., ♂, ♀: a state record.

Sympetrum occidentale fasciatum Walker, 9 ♂, 9 ♀: nearly one hundred individuals observed either mating or perching on wire fence oriented into the wind.

Sympetrum obtrusum (Hagen), 5 ♂, 1 ♀.

Sympetrum rubicundulum (Say), ♀.

Lestes congener Hagen, 2 ♂: a state record.

Lestes forcipatus Ramb., ♀: a state record according to Walker, 1952.

Lestes unguiculatus Hagen, 10 ♂, 6 ♀.

Ischnura verticalis (Say), 3 ♂: a state record.

Enallagma carunculatum Morse, 5 ♂, 3 ♀.

Enallagma civile (Hagen), ♂.

SOUTH DAKOTA:

Lawrence Co., Black Hills, 5 mi. S.W. of Deadwood on U.S. 85A, Aug. 3, 1955, E. J. and P. H. Kormondy.

Lestes disjunctus disjunctus Selys, 7 ♂: a state record according to Walker, 1952.

Lestes unguiculatus (Walsh), ♀.

Ischnura perparva Selys, ♂, ♀: a state record.

Enallagma hageni (Walsh), ♂: a state record.

Custer State Park, Black Hills, June 18-20, 1955, R. L. Fischer, W. Drew and R. W. Hodges.

Ophiogomphus severus Hagen, 2 ♂ June 18, ♂ and ♀ June 17: a state record.

Libellula quadrimaculata Linn., 2 ♂ and 1 ♀ June 18, ♂ June 19, ♀ June 20.

Argia vivida Hagen, ♂ June 17: a state record.

Amphiagrion abbreviatum (Selys), 6 ♂ and 1 ♀ June 18, ♀ June 19, ♂ June 20: a state record; see notes below.

Ischnura damula Calvert, ♀ June 18: a state record.

Ischnura perparva Selys, 1 ♂ and 3 ♀ June 18, 5 ♂ and 1 ♀ June 19: a state record.

Ischnura verticalis (Say), ♂ June 18: a state record.

Enallagma anna Williamson, ♀ June 20: a state record.

WYOMING:

Niobrara Co., 20 mi. S. of Lusk, June 22, 1955, R. L. Fischer, W. Drew and R. W. Hodges.

Ischnura perparva Selys, 4 ♂: a state record.

Enallagma anna Williamson, 5 ♂.

ARIZONA:

Cococino Co., Grand Canyon, North Rim, near Cape Royal, Aug. 23, 1955, E. J. and P. H. Kormondy.

Aeshna interrupta interna Walker, ♀ : a state record.

WASHINGTON:

Pierce Co., Mount Rainier, near Emmen's Glacier, 5000 ft., Aug. 11, 1955, E. J. and P. H. Kormondy.

Tanypteryx hageni (Selys), ♀.

Notes on *Amphiagrion abbreviatum* (Selys)

The specimens of *Amphiagrion abbreviatum* reported above from South Dakota are of interest because they occur in what appears to be a possible zone of overlap with the closely allied *A. saucium* (Burm.). According to the distribution as given by Walker (1953), the eastern *saucium* occurs as far west as Wisconsin and possibly Minnesota (Walker suggests that the Minnesota records [Whedon, 1914] might belong to another, as yet undescribed species); the western *abbreviatum* occurs eastward as far as Kansas. Kennedy (1917) reported both *saucium* and *abbreviatum* (as a variety of *saucium*) from western Kansas.

The rather robust, hairy and dark-hued specimens at hand with the intersternum raised into a very prominent knob are unmistakably *abbreviatum;* the anal appendages of the male are clearly those of *abbreviatum*. By size criteria, however, the specimens are intermediate and more closely approximate *saucium* (see Walker, 1953). Measurements(in mm.) made on the 7 ♂ and 2 ♀ are as follows: Total length ♂ 24.9 (23.2-25.5), ♀ 25.9 (25.2-26.6); thorax length ♂ 4.4 (4.0-5.0), ♀ 4.5 (4.3-4.7); abdomen length ♂ 19.0 (18.0-20.8), ♀ 19.8 (19.3-20.2); hindwing length ♂ 14.8 (14.1-16.1), ♀ 15.7 (15.2-16.1); metathoracic femur length ♂ 2.4 (2.1-2.7), ♀ 2.7 (2.6-2.7); pterostigma length (along costa) ♂ 0.6 (0.5-0.8), ♀ 0.4; head width ♂ 3.8 (3.6-3.9), ♀ 3.8 (3.7-3.8).

Specimens of *abbreviatum* from Yellowstone Park, Wyoming in the Williamson-Kennedy collection are of the larger size recorded by Walker. The possibility then exists that there is a size-cline westward in *abbreviatum* and that the specimens at hand are from the eastern and smaller size limits of this species. In discriminating between the two species in this zone more attention must therefore be paid to morphological features than to measurements.

LITERATURE CITED

Kennedy, C. H. 1917. The Dragonflies of Kansas with Reference to their Distribution. Univ. Kansas, Dept. Ent. Bull. 11:129-145.

Walker, E. M. 1952. The *Lestes disjunctus* and *forcipatus* Complex (Odonata: Lestidae). Trans. Amer. Ent. Soc. 78:59-74.

Walker, E. M. 1953. The Odonata of Canada and Alaska, Vol. 1. Univ. Toronto Press, xi + 292 pp.

Whedon, A. D. 1914. Preliminary Notes on the Odonata of Southern Minnesota. Rept. Minnesota State Entomologist:77-103.

A NEW SPECIES OF *PENTHALEUS* FROM MEXICO (Acarina: Penthaleidae)[1]

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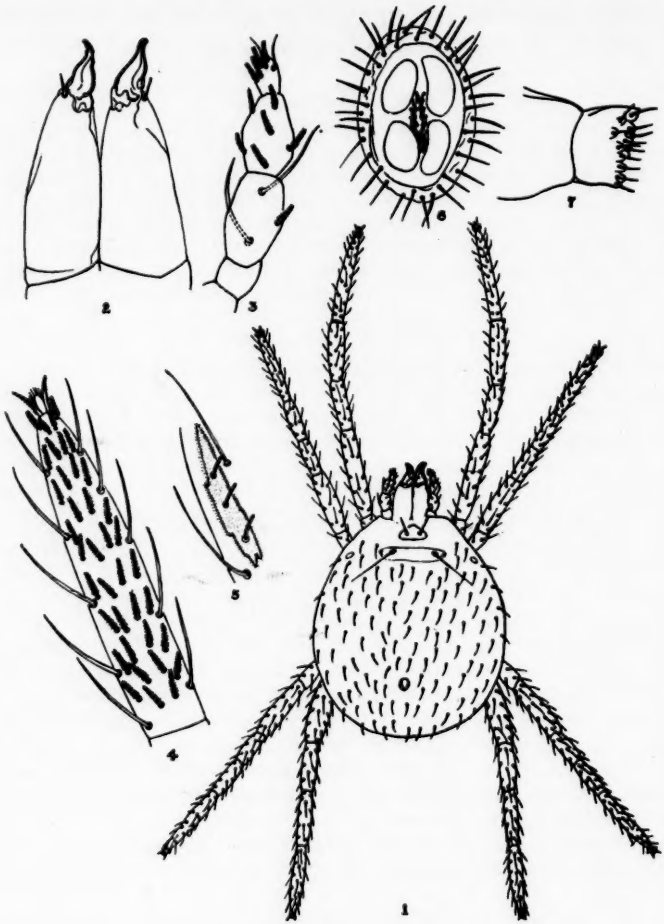
Two species of the genus *Penthaleus* Koch, 1835, namely, *Penthaleus major* (Dugès), 1834 and *Penthaleus minor* R. Canestrini, 1886, are at present known to occur in North America. During the summer of 1956, in continuation of an investigation program on the plant-feeding mites of Mexico, collections made by Dr. Robert E. Beer were found to contain a new mite species in the family Penthaleidae Oudemans, 1931.

Penthaleus crinitus, new species

ADULT FEMALE. Body oval, narrow in front, broadly rounded posteriorly, broadest at mid-length, conspicuously divided into gnathosoma and idiosoma. *General setation:* Body and legs with simple, short, flexible setae; dorsal surface with numerous setae almost uniformly spaced, setae 40-45 μ long; ventrally setae more numerous than on dorsum and shorter than dorsal setae, length of setae, 25-30 μ; special senory setae occur on vertex of idiosoma, leg tarsi, in penthaleus organs on tarsi and tibiae I and II. *Gnathosoma:* Conical, longer than broad, length 300 μ, width 210μ, bearing dorsally a pair of chelicerae and ventrally a pair of palpi and hypostome. Chelicerae almost three times as long as broad, conical, two-segmented, basal segment broadly conical, produced anteriorly into a thin membranous extension representing vestige of immobile digit; second segment or movable digit heavily sclerotized, thickened basally, gradually tapering to a narrow, blunt, slightly curved chela; a single, simple seta on basal segment opposite point of articulation of movable chela. Palpi four-segmented, thin and long, located ventrally on gnathosoma, palpal bases or coxae fused in part with hypostome; the first visible segment (trochanter) small, slightly longer than wide and nude; femur about two and one-half times as long as broad, bearing dorsally two long, tactile setae and a short plumose seta ventrolaterally; genu slightly longer than second segment, bearing a total of six plumose setae, three dorsal, other three ventral in position; tibiotarsus, the smallest of palpal segments, about one-third as long and one-half as broad as genu, conical in shape, with a slightly bevelled inner edge, bearing dorsally four plumose setae and ventrally two, long, simple setae. *Idiosoma:* Broadest at mid-length, with a soft projection anteriorly, the vertex, projecting over the base of the gnathosoma, bearing two needle-shaped setae, length of setae, 45 μ. Pseudostigmatic area not distinct, in transverse alignment with legs II, with a pair of long, glabrous, finely tapering setae, length of setae, 120 μ. A pair of eyes, one on either side on the dorsum near the

[1] Contribution number 964 of the Department of Entomology, University of Kansas.



EXPLANATION OF FIGURES

Penthaleus crinitus n. sp.: 1. Adult female, dorsal aspect; 2. Chelicerae; 3. Palpus; 4. Tarsus I, ventral aspect; 5. Penthaleus organ and annulated setae; 6. Genital area; 7. Ovipositor.

margin of body and behind second pair of legs. Anus located dorsally about one-third the distance from posterior end of idiosoma in transverse alignment with coxae IV, with a circumanal area having no anal setae. Genital aperture ventral, in transverse alignment with coxae IV, with two genital folds, one on either side; genital folds projecting prominently, with two genital suckers each, and with two rows of simple setae, one row on the outer, the other on the inner margin; with seven pairs of plumose setae on either side of the genital aperture; genital suckers acetabulate; ovipositor short, broader than long, with ten to twelve lobes at distal end, each lobe with a single simple seta. *Legs:* Four pairs of legs arranged in two groups, with coxae of legs I and II coalesced on propodosoma; similarly coxae of legs III and IV on metapodosoma; legs I and IV longer than legs II and III; all legs six-segmented; all leg segments beset with simple setae in addition to specialized setae described below. Tarsi ending in a median, rayed empodium and a pair of rayed claws; venter of tarsi with special plumose setae in four longitudinal rows, the setae of each row alternate with the member in the next row. Tibiae and tarsi I and II dorsally with special sensory areas, penthaleus organs, the periphery of the organ appearing ciliated due to the presence of very minute setae; two or three annulated, hollow sensilla arising from pitlike bases along the middle of the organ, these sensilla short and blunt at tips; two to three long, hollow, annulated, finely attenuating setae on dorsum of tibiae and tarsi I and II. Lengths of leg segments in μ from trochanter to tarsus of legs I to IV in sequence: trochanters, 50,40,40,50; femora, 260,180,175,260; genua, 140,110,105,140; tibiae, 200,160,160,200; tarsi, 210,170,170,210.

Length of body from tip of gnathosoma to end of opisthosoma, 880 μ.

Penthaleus crinitus can be distinguished from both *Penthaleus major* and *Penthaleus minor* by its chelicerae, absence of anal setae, presence of four rows of plumose setae on under surfaces of tarsi and seven pairs of short plumose setae on either side of the genital opening. The eggs are irregularly oval, with a reticulate pattern on the outer covering. Males of this species have not been collected.

Holotype: Female; Mexico City—Cuernavaca Highway No. 95 (Kilometer 58), Morelos, Mexico. June 30, 1956. R. E. Beer, under rocks.

Paratypes: Five females, same collection data as holotype.

Location of types: Holotype and five paratypes in the Snow Entomological Museum, University of Kansas, Lawrence, Kansas.

NEW RECORDS AND DESCRIPTIONS OF MILLIPEDS OF THE FAMILY CLEIDOGONIDAE (Order Chordeumida)

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Holotypes of the millipeds described in this paper will be deposited in the American Museum of Natural History. A male paratype of *Cleidogona caroliniana* will be deposited in the museum of the North Carolina Department of Agriculture and a female paratype of *Cleidogona propia* in the collection of Dr. O. Bolívar, Instituto Polytécnico Nácional, Mexico City. Other specimens will remain in the author's collection.

Genus *Cleidogona*

Cook and Collins, 1896, Ann. New York Acad. Sci. 9(1-3):41-43.

Numerous species of this genus occur from Guatemala northward as far as Minnesota and New York.

Cleidogona exaspera

Williams and Hefner, 1928, Ohio Biol. Sur., Bull. 18, p. 117, fig. 14 B.

Records: Mt. Mitchell, Buncombe Co., North Carolina, leaf mould, Sept. 29, 1950, D. L. Wray; Gate 11, Duke Forest, Durham Co., North Carolina, leaf mould, Nov. 25, 1952, A. S. Pearse.

This species, the following two described here, and one described by Hoffman (1950) bring to four the number of species of this genus known to occur in North Carolina.

Cleidogona wrayi, new species

Plate I, Figures 1-3

Diagnosis: This species is distinguished by the posterior branch of the gonopod, which is arched; the apical region is thin and expanded, rather than clavate, as in most of the northern species.

Type locality: Acre, Beaufort Co., North Carolina, leaf mould, 1 male, Nov. 5, 1950, D. L. Wray.

Male holotype: Length about 17 mm., width 1.7 mm. Body medium brown above shading to tan on the sides and below; metazonites of the middle body segments each with six light colored spots, of which the outer two are larger and transversely oval and the other four are small and longitudinally oval. Antennae and top of head brown. Eyes black, the ocelli in series of 7, 6, 5, 4, 3, (1). Legs tan at base, shading to brown distad.

The ninth legs are as shown in figure 1. The coxae of the tenth and eleventh legs have each the usual glandular opening on the mesial surface; in addition, there are two thick lobes, each rounded and about as broad as it is long; the one on the mesial surface is finely spinose, but the other is plain. In front of the twelfth legs there is a cylindrical sternal peg that extends forward between the coxae of the eleventh legs.

The gonopods are as shown in figures 2 and 3. The anterior branch is

unusual in that the mesial angle of the apical region overlaps its mate and the lateral angle is produced as an acute process.

The female is unknown.

Cleidogona caroliniana, new species
Plate I, Figures 4, 5

Diagnosis: This is a small species with gonopods that are nearest those of the larger *C. fustis* Cook and Collins, 1896, and *C. exaspera* Williams and Hefner, 1928.

Type locality: Fayetteville, Cumberland Co., North Carolina, near a swamp, 4 males, Nov. 11, 1949, D. L. Wray.

Male holotype: Length about 10.5 mm., width 1.1 mm. Body with a single, broad, light brown band along the dorsum; sides, venter, and legs tan. On the middle body segments the dorsal band is broader on the metazonites than on the prozonites; it is interrupted on each metazonite by a transverse, tan, marginal stripe and by four tan spots which are more or less centered by the middle four segmental setae; the medial spots are small and round, the others larger and ovoid. Antennae and top of head brown. Eyes black, the ocelli in series of 7, 6, 5, 4, 2, 1.

The ninth legs are as in *C. exaspera* except that there is no acute process on the apex of the first segment. The coxae of the tenth and eleventh legs have each a cylindrical lobe through which the coxal gland opens; the lobe is about as long as it is broad. In addition, on each of the tenth coxae there is a smaller, finger like lobe adjacent to and about the same length as the glandular lobe. The sternal process in front of the twelfth legs is cylindrical, about half the length of the coxae of the tenth legs, and the ventral margin bears a minute, acute lobe. It extends forward between the coxal lobes of the eleventh legs.

The anterior branch of the gonopod has the apical region divided, as shown in figure 4. The posterior branch is arched and its apical region is much enlarged. The anterior view of the gonopods is shown in figure 5.

The female is unknown.

Cleidogona moderata, new species
Plate I, Figures 6, 7

Diagnosis: The gonopods and ninth legs of this species closely resemble those of *C. godmani* Pocock, 1910, from which it is distinguished by the rounded apex of the anterior branch of the gonopod and by the smaller body size.

Type locality: 18 miles south of Tamazunchale, San Luis Potosí, Mexico, 1 male, Nov. 22, 1946, E. R. Ross.

Male holotype: Length about 16 mm., width 1.5 mm. Body with a broad, dark brown band along the dorsum and a narrow and less well marked brown band on each of the sides just below the lateral segmental setae. Venter a pale cream color. Metazonites of the middle body segments each with four dorsal, light colored, round spots which are more or less centered by the four dorsal segmental setae. Middorsal line white, very narrow. Legs pale cream color at base, shading to brown distad.

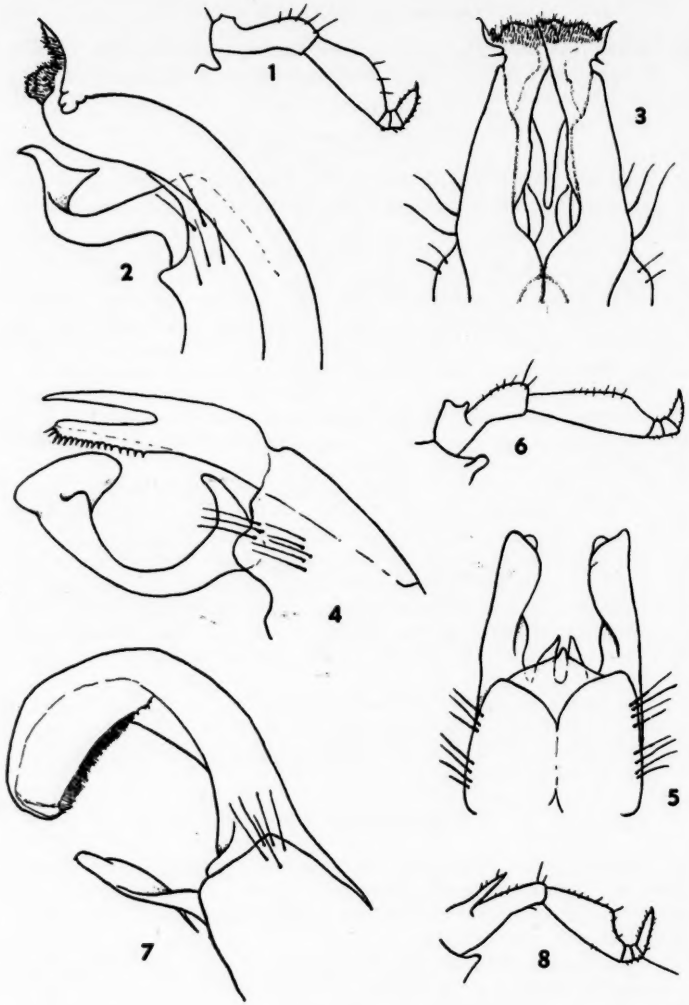

PLATE I

Cleidogona wrayi, n. sp., male holotype. Fig. 1. Ninth leg. Fig. 2. Left gonopod, lateral view. Fig. 3. Gonopods, anterior view.

Cleidogona caroliniana, n. sp., male paratype. Fig. 4. Left gonopod, lateral view. Fig. 5. Gonopods, anterior view.

Cleidogona moderata, n. sp., male holotype. Fig. 6. Ninth leg. Fig. 7. Left gonopod, lateral view.

Cleidogona zimapaniensis, n. sp., male holotype. Fig. 8. Ninth leg.

The ninth legs, as shown in figure 6, have each a large cylindrical lobe on the first segment. The coxae of the tenth and eleventh legs have each a narrow, fingerlike lobe and a shorter, broader lobe adjacent to the glandular opening. The sternal process in front of the twelfth legs is cylindrical, acute, and much shorter than is usual in the genus; it is similar to the sternal process in *C. leona* Chamberlin, 1943, but much shorter.

A lateral view of the left gonopod is shown in figure 7. It is typical of other Mexican species of the genus in the simplicity of the anterior branch and the small size of the posterior branch. Of specific importance are the rounded apex of the anterior branch and the twisted posterior branch. From an anterior view of the gonopods the anterior branches are seen to be contiguous at the base, from which the inner margins diverge at an angle of about 35 degrees; the anterior branches are slightly but evenly narrowed distad, and the apex is rounded.

The female is unknown.

Cleidogona zimapaniensis, new species
Plate I, Figure 8; Plate II, Figures 9-12

Diagnosis: This species is distinguished by the presence of a long, acute, retrorse process on the first segment of each of the ninth legs of the male.

Type locality: 14 miles north of Zimapán on the Pan-American Highway, Hidalgo, Mexico. 1 male, 1 female, June 23, 1954, N. B. Causey.

Male holotype: Length about 14 mm., width 1.4 mm. Anterior half of body with a single, broad, middorsal, brown band; at about the middle of the body it divides into two. Irregular light brown and tan areas on the sides and extending well into the venter form an intermittent, indistinct band on each side below the lateral segmental setae. Metazonites each with four round or ovoid spots that are more or less centered by the four dorsal segmental setae. Venter tan. Legs tan at base, shading to brown distad. Antennae and top of head brown. Eyes black, the ocelli in series of 7, 6, 5, 4, 3, 2.

The ninth legs are as shown in figure 8. The coxae of the tenth and eleventh legs have each the opening of the coxal gland at the apex of a thick, cylindrical lobe that is about twice as long as it is broad; no other lobes are on these legs. The sternal process (figure 9) in front of the twelfth legs is a flattened piece, a little constricted at the base, that extends forward between the glandular lobes of the eleventh legs.

The gonopods resemble those of other Mexican species in the simple anterior branch and the short, weak posterior branch, as shown in the lateral view of the left gonopod in figure 10. Of specific importance is the subapical process on the outer curvature of the anterior branch. Figure 11 shows an anterior view of the gonopods *in situ*.

Female paratype: Length about 15.5 mm., width 1.5 mm. Other somatic characters are as in the male.

The vulvae are shown from a posterior view in figure 12. They are most easily distinguished from those of other Mexican species by the narrow medial process of the skeletal piece.

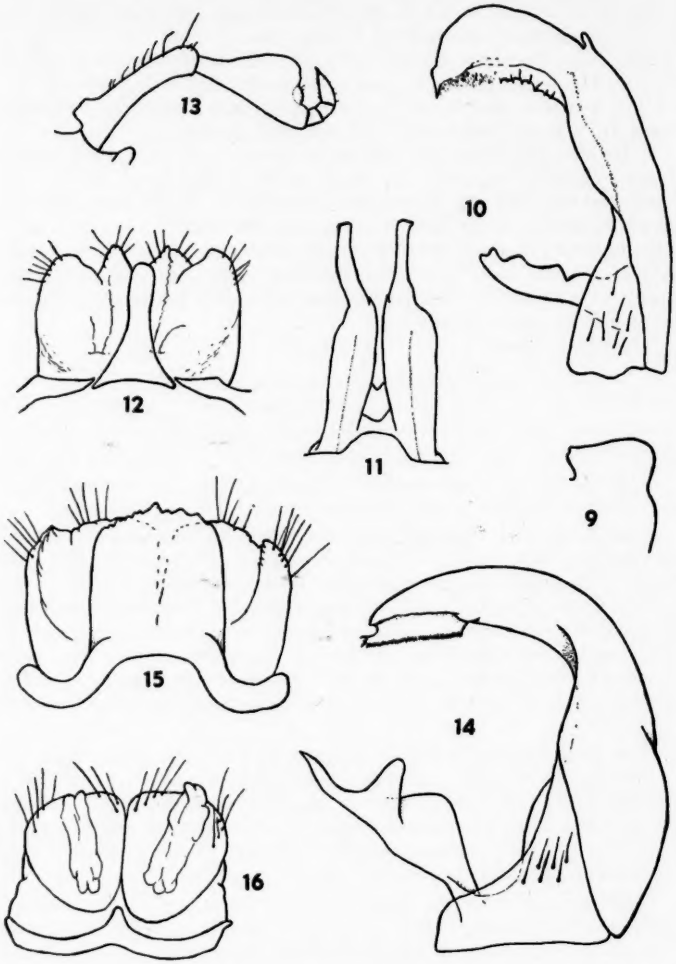

PLATE II

Cleidogona zimapaniensis, n. sp., male holotype, female paratype. Fig. 9. Sternal process. Fig. 10. Left gonopod, lateral view. Fig. 11, Gonopods, anterior view, drawn to a smaller scale. Fig. 12, Vulvae, posterior view.

Cleidogona propia, n. sp., male holotype, female paratype. Fig. 13. Ninth leg. Fig. 14. Left gonopod, lateral view. Fig. 15. Vulvae, posterior view.

Cleidogona secreta, n. sp., female holotype. Fig. 16. Vulvae, posterior view.

Cleidogona propia, new species
Plate II, Figures 13-15

Diagnosis: The ninth legs and gonopods of this species most closely resemble those of the much smaller *C. nueva nueva* Chamberlin, 1940. In size it is near *C. mexicana* (Humbert and Saussure, 1869), for which the ninth legs and gonopods have never been described.

Type locality: Mexican highway number 15, near Puerto Las Peras, Michoacán, Mexico. 1 male, 2 females, June 15, 1955, David Causey.

Male holotype: Length about 22 mm., width 2.1 mm. Body with four dark longitudinal bands; dorsal bands dark brown, almost black; lateral ones medium brown; space between dorsal bands less than the width of the bands; lateral bands contiguous with and below the lateral segmental setae. Middle segmental setae located each on a large, oval, tan area; medial segmental setae set each on a small, oval, tan area. Venter and proximal parts of legs tan; distad the legs are mottled brown. Top of head and proximal half of antennae brown; distad the antennae are tan. Eyes black, the ocelli in series of 7, 6, 5, 4, 3, 1.

The ninth legs, as shown in figure 13, have each the second segment enlarged conspicuously, as in other species in Michoacán, but with a low mound on the distal surface of the enlargement. The coxae of the tenth and eleventh legs have each the opening of the coxal gland at the apex of a thick, cylindrical lobe that is about two and one-half times as long as it is broad. The sternal process in front of the twelfth legs is flattened, almost rectangular, with the vertical length about twice the longitudinal length; it extends forward between the glandular lobes of the eleventh legs.

The gonopods (figure 14) resemble those of other Mexican species in the simplicity of the anterior branch; the posterior branch is nearest that of *C. nueva.* In anterior view the anterior branches are almost contiguous along the basal one-third of their length; distad they gradually diverge about 30 degrees.

Female paratype: Length about 18 mm., width 1.8 mm. Other somatic characters are as in the male.

The vulvae are shown from a posterior view in figure 15. The skeletal element is unusual in that the medial extension is as broad and as long as each of the vulvae.

Cleidogona secreta, new species
Plate II, Figure 16

Diagnosis: This species is distinguished by the very short medial projection on the skeletal element that is at the base of the vulvae.

Type locality: Oaxaca, Oaxaca, Mexico, in leaves under trees in the ravine in front of the Oaxaca Courts, 1 female, June 24, 1955, N. B. Causey.

Female paratype: Body length about 13 mm., greatest width 1.6 mm. Body lighter colored than is usual; dorsum with two longitudinal brown bands, each about half as wide as the middorsal cream-colored band between them; irregular light brown areas form an intermittent band on each side below the lateral segmental setae. Medial segmental setae set on the medial cream-colored band; middle segmental setae each set in a small, oval, tan

area that interrupts the dorsal brown band. Venter and base of legs light tan; legs darker distad. Eyes black, the ocelli in series of 7, 6, 5, 4, 3, 2.

The vulvae are shown from a posterior view in figure 16. The skeletal piece is unusual because the medial extension is so short and so narrow.

Cleidogona sp.

Record: Puerto Las Peras, Michoacán, Mexico, 2 females, June 15, 1955, David Causey. Length 12 mm. Body with a broad, dark brown band along the dorsum and a narrow and less well marked brown band on each of the sides just below the lateral segmental setae. Ocelli in series of 7, 6, 5, 4, 3, 2, 1. The vulvae are much as in *C. secreta,* but the skeletal piece differs in that there are two short anteriorly directed branches rather than one.

Genus *Tiganogona*

Chamberlin, R. V., 1928, Ent. News 39:154.
Causey, N. B., 1951, Jour. Washington Acad. Sci. 41(2):82.

The two species of this genus are known to occur in Illinois, Missouri, and Arkansas.

Tiganogona moesta

Causey, N. B., 1951, Jour. Washington Acad. Sci. 41(2):82-83, figs. 22, 23.

Record: Alton, Oregon Co., Missouri, 1 male, 1 female, Mar. 15, 1955, W. F. Rushton. This species is easily distinguished from the genotype, *T. brownae,* by the broader, shorter lobe on the first article of the ninth legs of the male.

Rhinocricus dispar Causey: A Preoccupied Name

NELL B. CAUSEY
Fayetteville, Arkansas

The substitute name *Rhinocricus morechalus* is proposed for *R. dispar* Causey, 1954 (Proc. Biol. Soc. Wash., vol. 67, p. 60), which is a specific homonym of *R. dispar* Silvestri, 1895 (Boll. Mus. Torino, vol. 10(203), p. 12.) This error was called to my attention by Dr. Otto Schubart and by Mr. Richard L. Hoffman.

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